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CORRECTIONS

ERA Vol. 2, No. 10, Abst. 25302, line 5 should read: (USA)). 1976. Contract W-7405-ENG-26. 46p. Dep. NTIS, PC A03/MF A01.

ERA Vol. 2, No. 21, Abst. 50810, line 1 should read: (CONF-761086-P1) Second symposium on coal preparation.

ERA Vol. 3, No. 7, Abst. 15513, line 1 should read: (COO-4217-T1) Plastic deformation in oxide ceramics.

ERA Vol. 3, No. 8, Abst. 19124, line 1 should read: (COO-4217-T2) High temperature plastic deformation in

ERA Vol. 3, No. 9, Abst. 21411, line 3 should read: 16p. (NP-22638).

ERA Vol. 3, No. 10, Abst. 23712, line 4 should read: sor, Conn. (USA)). Dec 1975. 99p. Dep.

ERA Vol. 3, No. 10, Abst. 23713, line 4 should read: (USA)). Apr 1976. 163p. Dep. NTIS, PC

ERA Vol. 3, No. 11, Abst. 27332, line 1 should read: (LBL-3770) Proton and pion spectra at large angles in

ERA Vol. 3, No. 12, Abst. 29304, line 1 should read: (BNL-23637) Induction-type bivane to measure vertical

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ERA Vol. 3, No. 17, Abst. 39353, line 1 should read: (DOE/EV-0005/3) Formerly utilized MED/AEC sites

ERA Vol. 3, No. 17, Abst. 41167, line 1 should read: (COO-2754-3) Structure of glasses containing transition

ERA Vol. 3, No. 17, Abst. 41784, line 1 should read: (ORNL-tr-4623) Pollution of the ocean. Schuetzler, A.

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Abey, A., *See* Schatz, J., 3:1561
Abey, A.E., Apparatus for deformation tests at intermediate strain rates—10^{-2} to 10^{-3} s^{-1}—and at high pressure, 3:1118 (UCRL–79012)
Abou-Sayed, A.S., *See* Jones, A.H., 3:202

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 50492

49339 Bituminous Coal Day 1977. *Bergbau;* **28**: No. 12, 482-491(Dec 1977). (In German).

From Hard coal day; Essen, Germany, F.R. (24 - 25 Oct 1977).

The report summarizes the lectures given at a meeting on the occasion of the Bituminous Coal Day 1977 (Oct. 24, 1977 at Essen, FRG). After a general review on the progress in the technical development in the coal mining industry and on objectives for research work on the coal mine of the future, in the field 'mining techniques and safety' lectures were given on the following topics. 1) advance technique and field prospecting - prerequisites for an optimum utilization of our deposits 2) the economic utilization of our deposits - objectives and tasks for the development of progressive mining techniques 3) safety in the future coal mining industry 4) planning, dimension and infrastructure of modern bituminous coal mines. In the field of coal upgrading and utilization lectures were given on 1) the coking industry-balance and guidelines for the 80ies 2) opportunities for coal gasification 3) Fluidized-bed combustion as a new technology for the generation of electricity and heat from coal.

PROCESSING

49340 Microbiological activity in relation to coal utilisation. Part II. Coal and hydrocarbons. Ponsford, A.P. *Br. Coal Util. Res. Assoc., Mon. Bull.;* **30**: No. 2, 41-71(1966).

The degree of microbial action in the formation of coal deposits is somewhat controversial. The majority view is that microorganisms aid in the breakdown of plant remains leading to the formation of peat and that later coalification charges are due to the temperatures and pressures resulting from the deep burial of peat. While the use of microorganisms for making bread curd wine has been known for a long time, the knowledge that microorganisms were involved is relatively recent (Pasteur), and the knowledge that microorganisms can metabolize hydrocarbon (paraffin wax, methane, aromatic hydrocarbons, crude oils, etc.) represents still more recent discoveries. Published information on the types of microorganism attacking various hydrocarbons is linked with dates of publication. This knowledge is then summarized. Finally, possible applications are developed: desulfurization of coal by microbial leaching; use of waste coal fines as a source of humus and to promote nitrogen fixation in agriculture; and the production of microbial foods. The processes involved in these applications are discussed briefly. (LTN)

CARBONIZATION

REFER ALSO TO CITATION(S) 49360, 49376, 49500, 49503

49341 Computer calculation of carbonizing periods. Frumkin, V.M.; Anokhin, V.P.; Kulakov, N.K. *Coke Chem., USSR (Engl. Transl.);* No. 11, 15-18(1976).

Translated from Koks Khim.; No. 11, 12-15(1976).

An algorithm and program have been compiled for use on the Nairi-S digital computer. The existing method of calculating carbonizing periods is approximated by a mathematical model in the form of a 1st-order polynomial, which gives results accurate to within +- 3% compared with the existing method. A nomograph has been constructed for finding carbonizing periods. A relationship has been derived from experimental data, for applying the same method to calculations on preheated charge.

49342 (DOE-tr—100) **Technical information on processes for the utilization of coal: high temperature coking of lignites (BHT (lignite high-temperature) coking).** Sep 1977. Translation: source information not available. 21p. Dep. NTIS, PC A02/MF A01.

In the high temperature coking of lignite (BHT coking), briquets of very fine granules are used to obtain BHT coke, BHT tar, middle oil, light oil, and gas. Accordingly, the overall process is composed of two process segments: Briquetting and the coking of these briquettes in vertical chamber ovens. A normal coking plant consists of 20 oven batteries each consisting of 4 coking ovens each of which contains baking chambers, which are operated at a level of 95 percent of capacity. The coke production from each coking chamber amounts to about 11 tons per day. The further processing of the principal products, coke and gas, is carried out in conventional units which, depending on the local conditions and other factors, are laid out for the entire coking plant as two or more processing lines. Additional units are necessary for the processes shown below in operating a lignite coking plant for the production of BHT coke and the discharge of gas as city gas at a pressure of about 2500 kPa/cm^2: Briquette factory, industrial power plant, crude gas compression, gas desulfurization and CO_2 removal, gas drying, gas liquor workup, separation and workup of the liquid products, tank farm, coke storage and shipment, provision of electrical energy, and provision of cooling water. (LTN)

49343 Coal carbonization in India. Nandi, C.; Ghosh, A.K. *J. Mines, Met. Fuels;* **25**: No. 7, 208-213(Jul 1977).

In India low temperature carbonization is used to make domestic coke, and high temperature carbonization is used to make metallurgical coke or town gas. Fluidized carbonization produces semicoke which is used to make domestic smokeless fuel or metallurgical coke. Products of the different types of carbonization are indicated, and the pyrolysis process is described briefly. Beehive ovens, modern coke ovens, and gasmaking retorts are described. Indian reserves of prime coking coals are 5651 million tonnes, plus 9433 Mt of medium coking coals, 5070 Mt of blendable coals, and 12,896 Mt of non-coking coals, including lignite.

49344 Calculating the heating field in a bed of lump material. Kukarkin, A.S. *Khim. Tverd. Topl.;* No. 2, 146-150(Mar 1977). (In Russian).

An algorithm has been developed for calculating temperature fields in a furnace using combined heating for the production of formed coke. It is possible to analyse the thermal state of the furnace for various operating conditions with the object of arriving at optimum heating conditions for the coal briquette by changing the temperature of the furnace walls and the rate at which gas passes through the bed.

49345 Activated carbon produced from intermediate products of the preparation of moulded coke. Colaiacovo, F.; Colletta, A.; Di Stefano, V.; Marini, P.; Palumbo, L. (to Centro Sperimentale Metallurgico, Rome (Italy)). German(FRG) Patent 2,616,543/A/. 21 Oct 1976. 9p. (In German).

A method is described to manufacture activated carbon showing a considerably improved efficiency compared to hither to methods. The activated carbon is especially obtained from intermediate products occuring in the manufacture of moulded coke. The starting coal is subjected to chemical and physical treatment in various reaction stages in a number of fluidized bed reactors. The coal is ground and dried with asuitable gasous mixture. In the first half of the coking stage, the coal is heated to 400 to 600°C, in the second stage to 800 to 1100°C for given treatment times with a suitable gas mixture. The partial combustion of the carbon-contained products in

an oxidizing atmosphere is interrupted as soon as the loss of weight of these products is between 10 and 40%.

49346 Temperature conditions during carbonization. Nazarenko, B.G.; Bronnikov, V.K.; Litmanovich, I.M.; Belov, K.A.; Zhidko, A.S. *Coke Chem., USSR (Engl. Transl.);* No. 11, 19-20(1976).
Translated from Koks Khim.; No. 11, 15-17(1976).
Investigations on No. 6 battery at Yasinovka with reference to identifying and setting optimum temperature conditions for easy pushing are reported.

49347 Temperature distribution in coke-oven battery brickwork. Krivoshein, V.T.; Aleshin, V.I.; Ignat'ev, V.L. *Coke Chem., USSR (Engl. Transl.);* No. 11, 21-24(1976).
Translated from Koks Khim.; No. 11, 17-20(1976).
A procedure has been developed and proposed for taking direct temperature measurements on and at various positions within coke-oven brickwork under actual commercial conditions, with particular reference to the end sections of the heating walls. It has been established that the wall surfaces exposed to fresh charge are drastically cooled over a short period (within 5 min of charging), and that steep temperature gradients are set up in the brickwork. These may obviously be responsible for the rapid failure of oven end sections. Data obtained under commercial conditions can be relied upon for the reliable calculation of temperature distributions in coke-oven brickwork. The proposed procedures for studying temperature distributions should prove useful in analyzing the causes of failure in the end-section brickwork and developing effective countermeasures. Thus, coke-oven brickwork undergoes repeated and serious thermal shocks and the surface temperature gradients become very considerable. This probably explains its premature failure, particularly in the end sections of the walls.

49348 Optimizing charge size analyses to maximize bulk density. Ivanitskii, V.G.; Shchegolev, S.V.; Solov'ev G.D.; Viuro, V.S.; Grechko, Yu.I.; Popel'nik, B.N.; Toryanik, E.I. *Coke Chem., USSR (Engl. Transl.);* No. 7, 4-6(1976).
Translated from Koks Khim.; No. 7, 4-6(1976).
Commercial trials have shown that for the coals currently supplied to the works the optimum degree of charge crushing is 76-77 percent below 3 mm. This increases the coke-oven output and leaves the coke quality at its former level. The use of stamped sieves instead of barred gratings in hammer crushers handling gas coals brings about a substantial improvement in their performance. The commercial adoption of a rational crushing scheme based on crushing each coal in the blend only to the degree necessary leads to a reduced crushing load and optimizes the size analysis of the charge for high bulk density without lowering coke quality. Two crushers have been shut down, reducing the over-all motor rating by 1050 kW. By introducing this rational coal-preparation scheme and optimizing the size analysis of the charge, savings of 790,000 roubles/year are being made at the Krivoi Rog Works.

49349 Charge traction forces in continuous ovens. Slyusar, I.P.; Veretel'nik, S.P.; Galushko, L.M. (Politechnic Inst., Donetsk, USSR). *Coke Chem., USSR (Engl. Transl.);* No. 7, 34-38(1976).
Translated from Koks Khim.; No. 7, 28-32(1976).
The procedure for determining the traction forces in horizontal continuous coke ovens is described.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 49373, 49973

49350 (ANL/ECT—3(App.A)(Pt.1)) **Environmental control implications of generating electric power from coal. 1977 technology status report. Appendix A, Part 1. Coal preparation and cleaning assessment study.** (Bechtel Corp., San Francisco, Calif. (USA)). Dec 1977. Contract W-31-109-ENG-38. 607p. Dep. NTIS, PC A99/MF A01.
This report evaluates the state of the art and effectiveness of physical coal cleaning as a potential strategy for controlling SO/sub x/ emissions in coal fired power generation. Coal properties which are significantly altered by physical coal cleaning were determined. The effects of the changes in properties as they relate to pulverized coal firing, fluidized bed combustion and low Btu gasification for combined cycle powered generation were studied. Available coal washability data were integrated by computer with U.S. coal reserve data. Approximately 18% of the demonstrated coal reserve were matched with washability data. Integrated data appear in the Appendix. Current coal preparation practices were reviewed. Future trends were determined. Five process flow sheets representing increasing levels of cleaning sophistication were prepared. The clean product from each flow sheet will meet U.S. EPA New Source Performance Standards. Capital and operating costs for each case were estimated. Environmental control technology and environmental impact associated with current coal preparation and cleaning operations were assessed. Physical coal cleaning is widely practiced today. Where applicable it represents the least expensive method of coal sulfur reduction. Developmental physical and chemical coal cleaning processes were studied. The chemical methods have the advantage of being able to remove both pyritic sulfur and organic sulfur present in the coal matrix. Further R and D efforts will be required before commercialization of these processes.

49351 Desulfurization of bituminous coal by means of bacteria. Golomb, M. (Siebtechnik G.m.b.H., Muehlheim (Germany, F.R.)); Beier, E. (Fachhochschule Bergbau, Bochum (Germany, F.R.)). *Bergbau;* **28**: No. 10, 419-422(Oct 1977).
It is firstly shown in which form sulphur occurs in coal and what consequences can be drawn from the sulphur content in the coal. To follow, the reader is informed about a few fundamentals of microbiology. In the main part, the time course of the oxidation of iron (II) salts and the time change of the oxygen concentration in the nutrient solution and then the oxidation of bituminous coal pyrite is shown. Finally, the conditions under which a desulphurization of bituminous coal with bacteria is economically justifiable are given.

49352 Method to purify coke-oven gas. Hoelter, H.; Gresch, H. German(FRG) Patent 2,505,959/B/. 7 Jul 1977. 4p. (In German).
To remove ammonia from the detared and cooled crude gas, water is added or, where appropriate, sulphuric acid. Hydrogen sulphide is stripped off in a washing cycle with sodium hydroxide or potassium hydroxide solution. Certain amounts of sodium or potassium hydroxide solutions are continiously added to thecycle whilst corresponding amounts of washing liquid are removed. The latter contains a relatively large quantity of sodium or potassium sulphite and from a waste liquor which can only normally be disposed of with great expense. The invention avoids this by mixing the washing liquid from the hydrogen sulphide washing cycle with the waste water from the ammonia washing in order to strip the ammonia (ammonium compounds) present in the latter. The thus necessary addition of slaked lime or other chemicals can be avoided and simultaneously the sulphite waste liquor is rendered harmless and hydrogen sulphide easily removable from the gas phase occurs.

49353 Method to purify the gas occuring in the pressure gasification of coal. Hoelter, H.; Gresch, H.; Igelbuescher, H. German(FRG) Patent 2,528,525/A/. 30 Dec 1976. 21p. (In German).
A method is described in which the gas occurring in the pressure gasification of coal is purified by washing with a wash oil, mostly tar oil. This has the following advantages as compared to the usual water washing: 1) Less cooling of the gas to be cleaned as the boiling point of the wash oil is between 250° and 360°C. 2) Due to the slighter cooling and the greater affinity of wash oil for heavy hydrocarbons and tar, these remain better dissolved so that incrustation in the cleaning apparatus is avoided. 3) The enriching of the gas with steam in the water wash is no longer necessary. The wash oil is fed into the circuit and continuously deposited and like the regeneration residues are fed again to the pressure reactor. The quantities of heat necessary for this are directly covered by a thermal oil also in the circuit. A flowsheet of the system is given.

49354 Processing method for gases containing hydrogen sulphide, ammonia and organic compounds. Goetza, F.; Mathiak, H.; Grossenbach, O.; Voigt, G.; Kurapkat, H. (to Ruhrkohle A.G., Essen (Germany, F.R.)). German(FRG) Patent 2,111,839/B/. 1 Jul 1976. 6p. (In German).
The invention describes a processing method for gases containing hydrogen sulphide, ammonia and organic compounds in which the hydrogen sulphide is washed out with an arsenic-containing solvent from the crude gas compressed in a pre-cooler, and elementary sulphur is yielded in an oxidizer from the solvent after adding a further catalyst, by the addition of oxidation air.

49355 Method to purify synthesis gas and fuel gas. Ahlborn, J.C.; Denchfield, J.R.; Estabrook, L.; McGann, R. (to Texaco Development Corp., New York (USA)). German(FRG) Patent 2,539,810/A/. 22 Apr 1976. 14p. (In German).
A method of purifying synthesis gas and fuel gas is described. The gas contains CO, H_2, entrained carbon particles and where given, sulphur components. The purification is carried out by contacting the gas flow with a liquid which at least contains a molten metal carbonate. The temperature during contact is between 593° and 871°C.

HYDROGENATION

REFER ALSO TO CITATION(S) 49373

49356 Heats of coal hydrogenation by differential scanning calorimetry. Cochran, H.D. *Fuel;* **57**: No. 2, 124-125(Feb 1978).
Exothermic heats of hydrogenation of various coals are plotted as a function of the oxygen content of the coals.

49357 Coal hydrogenation in the absence of solvents. Fractionation and determination of the molecular weight. Mehesch, H.; Hodek, W.; Koelling, G. (Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* 77/78: 283-294(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

The hydrogenation of coal in absence of solvents produces primary products whose analysis is not influenced by any parts of solvent. The presented paper reports the dependence of liquefaction rate and hydrogen consumption on temperature at a determined hydrogen pressure. The fractionation of the soluble hydrogenation products by Ultrafiltration and G.P.C. and the determination of the molecular weight (number and weight average) are described. The results (average molecular weight 200-120 000) are discussed.

49358 Process for coal hydrogenation. Benning, A.; Kneissl, H.; Wuerfel, H. (to Saarbergwerke A.G., Saarbruecken (Germany, F.R.)). German(FRG) Patent 2,444,827/A/. 8 Apr 1976. 11p. (In German).

In this process for the hydrogenation of coal, the coal is ground, mixed with oil components, the mixture preheated and hydated with hydrogen under suitable pressure, temperature and duration conditions. Hydrogenation takes place in the presence of an effective catalyst, the hydrated product is drawn off and distilled.

GASIFICATION

REFER ALSO TO CITATION(S) 49353, 49354, 49355, 49419, 49421, 49431, 49432, 49747, 49748, 49753, 50184, 50698

49359 (FE—1770-35) **Computer modeling of coal gasification reactors. Quarterly technical progress report, July 1, 1977—September 30, 1977.** Blake, T.R. (Systems, Science and Software, La Jolla, Calif. (USA)). Nov 1977. Contract EX-76-C-01-1770. 43p. (SSS-R—78-3446). Dep. NTIS, PC A03/MF A01.

The research on the fluidized bed computer code included the modification of the code to treat axisymmetric geometries. Test calculations were performed and studies were initiated to calculate the relative behavior of planar and axisymmetric bubble evolution. Analytical and numerical formulations of fluidized bed chemistry and hydrodynamics were examined, for the purposes of extending and improving the fluidized bed model. Specific numerical calculations of solids convection, with application to the synthane gasifier, were performed as part of a continuing investigation of jet and bubble formation at the distributor plate. The work on the entrained flow computer model involved the extension of this code to treat flows in three spatial dimensions. Subroutines in the new code were tested and calculations were initiated to simulate the gas dynamics and solid particle flows in a combustion stage of a two stage gasifier configuration. The formulation of a kinetics model for pulverized coal particles was continued. A model study of the relative influences of oxidation and gasification reactions upon mass loss from a carbon particle was completed. Included in this report as an appendix is "A Theoretical Study of Burning Carbon Particles" by P.A. Libby.

49360 (FE—2030-TR6) **Effects of impregnation of coal with potassium and sodium salts.** Marsh, H.; Walker, P.L. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Jan 1978. Contract EX-76-C-01-2030. 21p. Dep. NTIS, PC A02/MF A01.

Much interest has developed over the addition of potassium salts to potentially caking coals prior to their gasification. It is found that such addition markedly reduces the caking tendency of the coals, enabling them to be more easily handled in reactors. An extra bonus is found in that potassium is a good catalyst for both gasification of carbon in the presence of steam and the production of hydrogen via the water-gas shift reaction. In this report, mechanisms of how potassium salts may affect the fluidity of coal upon heating are considered. But first, what is known about the phenomenon of coking in the absence of potassium is reviewed at some length. The addition of potassium salts to caking coals is thought to reduce their fluidity primarily by increasing the number of cross-links which normally exist between the aromatic and hydroaromatic building blocks in the coal. Such an increase results, in turn, in an increase in molecular weight of the coal, decrease in its fluidity upon heat treatment, and the consequent decrease in mobility of planar regimes preventing their alignment to form anisotropic coke substance. It is suggested that the presence of potassium results in a higher oxygen content being present in the coal upon heating, either by reducing the rate of oxygen evolution from the coal as CO, CO_2, and/or water or by acting as an intermediate to extract additional oxygen from the steam added as a reactant to the system (that is, steam gasification). Thus, an increased oxygen content results in more crosslinking in the structure probably via ether linkages between aromatic and/or hydroaromatic regimes.

49361 (FE—2036-A1) **Liquid Phase Methanation Pilot Plant: installation and operation. Interim annual report, July 1, 1976—June 30, 1977.** (Chem Systems, Inc., New York (USA)). Oct 1977. Contract EX-76-C-01-2036. 78p. Dep. NTIS, PC A05/MF A01.

The Liquid Phase Methanation Pilot Plant was completed in Texas City, Texas and shipped to the Institute of Gas Technology HYGAS Pilot Plant in Chicago, Illinois. The unit was reassembled and installed. Check-out included pressure testing with nitrogen, cold oil circulation tests and, finally, several round-the-clock runs with process oil and nitrogen at conditions up to 550°F and 600 psig. The first batch of catalyst was loaded into the LPM reactor and reduced. The pilot plant was brought to stand-by conditions and fluidization tests were performed with liquid only. Three hours of HYGAS product were fed to the unit before an upset in the HYGAS clean-up section terminated gas flow. Later, the run was restarted on steam-methane reformer gas for an additional 25 hours. Catalyst activity was lower than expected. Run No. 2 performed with a second batch of catalyst involved 60 hours of operation with synthesis gas from IGT's steam methane reformer. Process variable scans confirmed the effect of synthesis gas flow rate and H_2/CO ratio as correlated from earlier laboratory experiments. Catalyst activity, however, was approximately $^1/_3$ lower than measured in the smaller units. A poor catalyst batch or an inadequate reduction procedure was suspected. In laboratory support work three new catalyst formulations were tested in the Process Development Unit. A new process liquid with a low pour point (-35°F) was also tested and found satisfactory for use in the pilot plant. The bench scale unit was run with a synthesis gas simulating the gas that would be obtained from IGT's steam-methane reformer (H_2/CO ratio = 6/1). The pilot plant experimental program was modified to make use of this auxiliary gas when the HYGAS Plant was not delivering coal-derived synthesis gas.

49362 (FE—2762-1) **Formation and control of fuel-nitrogen pollutants in catalytic combustion of coal-derived gases. Quarterly report, September 15—December 15, 1977.** Bracco, F.V.; Bruno, C.; Kim, B.S.; Santavicca, D.; Semler, J.; Walsh, P. (Princeton Univ., N.J. (USA). Dept. of Aerospace and Mechanical Sciences). 15 Dec 1977. Contract EF-77-S-01-2762. 9p. Dep. NTIS, PC A02/MF A01.

The objective of this research is to examine, both experimentally and theoretically, the conversion of fuel nitrogen to NO/sub x/ pollutants during the catalytic combustion of coal-derived gases. The nitrogen compounds most prevalent in these gases are ammonia and hydrogen cyanide. The effects and behavior of the principal sulfur impurity, hydrogen sulfide, will also be examined. The goal of the research is to determine the possibility of utilizing catalytic combustion to reduce NO/sub x/ emission from the combustion of coal-derived gases. The proposed work includes the determination of the concentration of ammonia in coal-derived gases by review of existing data; an experimental study of combustion in a catalyst honeycomb using a flow system with sampling probes and laser Raman diagnostics; and the construction of a theoretical model to explain the observed results. On the basis of this work, some elements of a strategy for minimizing NO/sub x/ formation in catalytic combustion will be developed.

49363 (SAN—1429-33) **Molten salt coal gasification PDU. Monthly technical progress report No. 25, April 1978.** (Atomics International Div., Canoga Park, Calif. (USA)). 11 May 1978. Contract EF-77-C-03-1429. 12p. Dep. NTIS, PC A02/MF A01.

49364 (SAND—78-0757C) **Instrumentation development for in situ coal gasification.** Northrop, D.A.; Bartel, L.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 20p. (CONF-780801—5). Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Sandia Laboratories designed, fielded, and evaluated seven instrumentation techniques on the Hanna II in situ coal gasification experiment conducted by the Laramie Energy Research Center in 1975—1976. Diagnostic techniques (thermal, in-seam gas sampling and pressure, and overburden tilt and displacement) were used to obtain data for process characterization. Remote monitoring techniques (electrical, passive acoustic, and induced seismic) are being developed to provide a real-time map of the in situ process to be used for process control. Assessments of these techniques clearly demonstrate the value of thermal instrumentation and analysis and the feasibility of electrical remote monitoring techniques.

49365 Synthane process update. Haynes, W.P.; Strakey, J.P.; Santore, R.R.; Lewis, R. (Energy Research and Development Administration, Pittsburgh). *Ind. Heat. (Pittsburgh);* **45**: No. 3, 12-15(Mar 1978).

The operation of the Synthane pilot plant has supplied promising data which, if translated to a large-scale coal gasification plant

for the production of SNG, would have significant economic impact. The gasifier has yielded a raw gas which has a hydrogen to carbon monoxide ratio of greater than 3 : 1, thus making it unnecessary to have a separate shift conversion unit. Furthermore, in the deep bed injection mode of operation, it produced a gas which is essentially devoid of tars and oils as well as phenols. This greatly simplifies gas and liquid treatment units as well as extensive phenol extraction units. Based on information from an economic study prepared by ERDA in which various coal gasification processes were compared for western coals, it is estimated that the deletion and/or simplification of the above units would result in a capital savings in the order of 5%; in other words, capital savings in the order of $60,000,000 could be projected. Since a large coal gasification plant would be highly capital intensive and since the capital cost represents approximately 70% of the cost of the gas produced, such a savings in capital amounts to about a 3 to 4% reduction in the cost of SNG. Various operating problems and failures of valves, centrifugal pumps, nozzles, etc. due to corrosion, erosion and stress corrosion respectively are discussed in some detail. Most of these problems have been resolved.

49366 Conversion of coal-based methanol to gaseous fuel proposed. Shirton, R.L. *Oil Gas J.;* **75**: No. 45, 106-109(31 Oct 1977).

The process involves the conversion of coal-based methanol to a gaseous mixture of 50% dimethyl ether, 33.3% hydrogen and 16.7% carbon monoxide. This gas mixture has properties similar to those of natural gas and cost of production would be 23 to 49 cents/MBtu above the cost of methanol. The advantages of the process and product are set out and theory and plant design explained. These are followed by a costs breakdown and economic appraisal.

49367 Pocess for the conversion of coal into benzine. Jacob, S.M.; Kuo, J.C.W.; Wise, J.J.; Garwood, W.E. (to Mobil Oil Corp., New York (USA)). German(FRG) Patent 2,615,142/A/. 21 Oct 1976. 31p. (In German).

The effective conversion of coal into liquid hydrocarbon benzine with a high octane number is described in the claimed method for coal enrichment. The coal is converted with O_2 and H_2O at about 788 to 982°C giving a synthesis product (containing CO, CO_2, H_2 and CH_4). The conversion of the carbon oxides and hydrogen to a product containing H_2O, C^-_4gas and C^+_5 aromatic benzine is catalyzed with a catalyst consisting of a crystalline alumino silicate zeolite with a SiO_2/AlO_2 ratio of at least 12 and a forced index of 1 to 12. The C^-_4gas is separated into a C^-_2residual gas (CH_4, C_2H_6, C_2H_4) and alkylation material (saturated and unsaturated C_3, C_4 hydrocarbons), the latter alkylated with strong acid at about 232°C, 35.2Kg/cm² pressure, the C_7/C_8 product is mixed with the aromatic benzine, the C^-_2residual gas steam reformed to an auxiliary synthesis gas and converted into a synthetic natural gas by methanation catalysts.

49368 Hydraulic binder-containing catalyst and its use in the methanation of carbon oxides and hydrogen-containing gases. Broecker, F.J.; Schwarzmann, M.; Kaempfer, K. (to BASF A.G., Ludwigshafen am Rhein (Germany, F.R.)). German(FRG) Patent 461,482/A/. 8 Jul 1976. 17p. (In German).

The invention describes a nickel carrier catalyst fastened by a hydraulic binder and its use in the methanation of carbon oxides and hydrogen-containing gases. The catalyst is prepared as follows: The compound $Ni_6MgAl_2(OH)_{16} \times CO_3 \times 4H_2O$ or $Ni_6Al_2(OH)_{16} \times CO_3 \times 4H_2O$ is precipitated out from an aqueous solution of nickel and aluminium salts onto zirconium dioxide and /or TiO_2 and/or Al_2O_3. The thus obtained precipitate is dried and calcined; the thus resulting roasted mass is mixed with calcium aluminate (alumina melt cement) and water, pressed and finally thermally treated.

49369 Report about the necessity and possibilities of a policy of the European Communities for sponsoring the gas production from coal. Burgbacher, F. (European Parliament, Luxembourg). pp 8-40 of Energiewirtschaftliche Bedeutung der Kohlevergasung. Frankfurt am Main, Germany, F.R.; ZfGW-Verl. (1975). (In German)

The resolution submitted by the Committee for Energy, Research and Technology of the European Parliament is stated and justified. With regard to the possibilities of using bituminous coal and lignite the following topics are discussed: a) Energy economics and political aspects of coal gasification, b) The situation in Western Europe, c) The use of and demand for gas, d) The definition of the term 'gasification', e) The history and the present state of gasification, f) Well-known and lesser known processes, g) New developments and possible trends of development. The justification section closes with a preview for the Federal Republic of Germany and Europe and with a sketch of technical directions in the further development of coal gasification, particularly using waste heat from nuclear reactors. The two appendices list coal gasification plant in use, and those which are planned and under construction.

49370 Coal gasification - a contribution to energy and raw material supply. Speich, P. pp 18 p. of Significance of coal gasification for energy economics. Frankfurt am Main, Germany, F.R.; ZfGW-Verl. (1975). (In German)

Predictions on energy demand lead one to expect a strong growth in electrical power, natural gas and oil. Coal gasification can gain great importance in the future for the manufacture of environmentally favorable power station fuel, which can be coupled with production of valuable carbon derivatives for the manufacture of synthetic and reduction gases for the chemical industry and the iron and steel industry, and above all for the manufacture of methane from coal, and thus the replacement of imported natural oil and gas energy. Coal gasification using process heat from high temperature reactors means the extension of coal supplies and can contribute to more favorable configuration of processes as regards costs and environmental conditions.

LIQUEFACTION

REFER ALSO TO CITATION(S) 49393, 49396, 49399, 49420, 49754

49371 (CONF-780454—1) **Separation of micron-sized particles from coal liquids: verification of surface charge.** Rodgers, B.R. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

From 84. national AICHE meeting; Atlanta, GA, USA (27 Apr 1978).

1, 5 and 10 μm particles of unconverted solids separated from coal liquid obtained in the SRC process were suspended in the process-derived filtered oil and the electrophoretic velocity measured in a microelectrophoresis apparatus. The viscosity, density and dielectric constant of the coal liquid were also measured. The calculated zeta potential was independent of particle size. It is suggested that entropic barriers may also contribute to the stability of the colloid. Calculated values of the charge double-layer thickness are sufficiently small compared to the particle size that a flat surface model assumed in the theoretical development would apply. (LTN)

49372 (FE—1216-3) **Assessment of technology for the liquefaction of coal.** (National Research Council, Washington, D.C. (USA). Ad Hoc Panel on Liquefaction of Coal). Dec 1977. Contract EX-76-C-01-1216. 165p. Dep. NTIS, PC A08/MF A01.

Of the four general methods of coal liquefaction, only indirect liquefaction (Fischer-Tropsch and methanol synthesis) currently is practiced on a commercial scale. Indirect liquefaction requires complex and expensive plants. Since the thermal efficiency of existing indirect liquefaction plants is 40 to 45 percent, coal consumption is very high. Pyrolysis processes for coal liquefaction produce gas, heavy liquids, and char; the heavy liquids require hydrogenation, and the char requires gasificationif clean fuels are to be produced. Pyrolysis does not appear promising for meeting the large liquid fuel requirements of the United States. The other two methods of coal liquefaction, solvent extraction and catalytic liquefaction, have been studied in a number of process configurations. These process schemes have resulted in thermal efficiencies of 60 to 65 percent and have produced 2 to 2.7 barrels of oil per ton of coal feed. At their present stage of development, there are difficult filtration requirements and, therefore, only those schemes yielding a product that can be recovered by vacuum distillation seem to be practical. A simple, economic method of separating unconverted coal and ash from nondistillate coal liquids remains to be demonstrated. Solvent extraction processes using donor solvents to produce a synthetic crude have been developed through the pilot-plant scale, and at least one process is ready for testing in a plant processing 200 to 600 tons per day. Of the processes for producing synthetic crude or low-sulfur heavy fuel oil by hydrogenation of a slurry of heavy oil and coal in the presence of a solid catalyst, only those in which the catalyst is kept in motion have been developed through the pilot-plant stage. The cost of synthetic crude oil from processes currently developed at least through the pilot-plant scale is estimated to be $20 to $30 per barrel (based on 1976 costs) or about twice the present cost of imported oil. (LTN)

49373 (FE—2011-10) **Catalysts for upgrading coal-derived liquids. Quarterly report, September 9—December 8, 1977.** Crynes, B.L. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 21 Dec 1977. Contract EX-76-C-01-2011. 66p. Dep. NTIS, PC A04/MF A01.

One experimental run conducted to assess the Co—Mo—Al_2O_3 catalyst (Nalcomo 474) activity to hydrotreat hydrocarbonization liquid from Union Carbide was prematurely shut down at 92 hours due to reactor plugging. At the Catalyst Life Test Unit two experimental run series with Rasyn oil resulted in premature shut down due to reactor plugging. Hydrotreating operations using Co—Mo—Al_2O_3 catalyst (Nalcomo 474) at 700F (371C), 1500 psig and for volume hourly space times of 1.25, 2.00 and 2.50 hours have resulted in reactor shut down within 375 hours of continuous oil-catalyst contact. Under similar operating conditions the hydrotreatment of Rasyn oil using the Ni—Mo—Al_2O_3 catalyst (Nalco NM-

502) resulted in successful operations of up to 674 hours of continuous oil-catalyst contact before voluntary reactor shut down. Both catalysts, Co—Mo—Al_2O_3 (Nalcomo 474) and Ni—Mo—Al_2O_3 (Nalco NM-502), have undergone a rapid hydrodenitrogenation activity decay during the first 150 hours of oil-catalyst contact. The hydrodesulfurization activity of the two catalysts also decreases with an increase in the number of hours of oil-catalyst contact (volumes of oil processed). The principal compound types present in the asphaltene strong acids isolated from a COED coal liquid have been identified. Both mass and infrared spectroscopy show that the OH group is the dominant functional group in the acid fraction and reveal the presence of carboxylic acids, the origin of which is not clearly established. The molecular data are consistent with the presence of compounds possessing 1 through 4 hydroxyl groups and up to at least 7 aromatic rings. The IR spectra of the asphaltene neutrals demonstrates that the oxygen-containing compounds in the neutral fraction are not characterized by the presence of OH groups.

49374 (FE—2353-16) **EDS coal liquefaction process development: Phase IIIA. EDS Process Capacity Factor study.** Fant, B.T. (Exxon Research and Engineering Co., Florham Park, N.J. (USA). Synthetic Fuels Engineering Div.). Jan 1978. Contract EX-76-C-01-2353. 31p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This report covers the EDS Process Capacity Factor Study, the purpose of which was to determine the incentive to provide additional investment or revised operating procedures to the Illinois Study Design to increase the plant capacity factor. The cumulative effect of base case plant additions, modifications, and operating changes is to increase the capacity factor of the plant to 90 percent. The additional investment required to provide the new facilities is about 135 M$ (1985, rural Illinois location). The increased capacity factor more than offsets this added investment and results in a coal liquids cost reduction of about 2 $/B.

49375 (FE—2353-19) **EDS coal liquefaction process development: Phase IIIA. EDS Process Alternatives LP Model. Interim report.** Fant, B.T. (Exxon Research and Engineering Co., Florham Park, N.J. (USA). Synthetic Fuels Engineering Div.). Jan 1978. Contract EX-76-C-01-2353. 92p. Dep. NTIS (US Sales Only), PC A05/MF A01.

This is an Interim Report on the development of the EDS Process Alternatives LP Model (PAM). PAM is a computerized linear programming (LP) Model of the EDS Coal Liquefaction process. The model was developed for use in process engineering and cost evaluation studies. PAM will be used to investigate the various process alternatives and their interactions to determine the economics of alternative configurations for the EDS process. A PAM case has been run to simulate the Illinois Base Case of the EDS Commercial Plant Study Design. The results were validated by comparing the PAM LP Model simulation with the Study Design. The report covers the development of PAM to simulate the Illinois Base Case of the EDS Commercial Plant Study Design. Included within are a brief introduction to linear programming, an outline of the components in the PAM LP-matrix, the process and project bases for the initial formulation of PAM and the results of the validation case. Attached are several sections covering the details of the process and utility information from which the PAM LP-matrix was developed.

49376 (FE—2422-10) **Fluid coking of coal liquefaction residues. Interim technical progress report for first residue.** Quinlan, C.W. (Exxon Research and Engineering Co., Baytown, Tex. (USA). Baytown Research and Development Div.). Jun 1977. Contract EX-76-C-01-2422. 66p. Dep. NTIS, PC A04/MF A01.

Work has been completed on coking the first coal liquefaction residue under ERDA Contract EX-76-C-01-2422. This first sample was H-Coal Solvent Precipitation Underflow. Sample characteristics caused operational problems which led to a modification of the program. These sample characteristics render questionable the representativeness of the sample and of the applicability of the data to the liquefaction process sequence from which this sample was generated. Nonetheless, the following statements can be made based upon the data obtained in the program: The H-Coal Solvent Precipitation Underflow sample contained a higher fraction of 1000°F$^-$ material than a typical coker feedstock. The maximum liquid product recovery for this sample appears to occur in the 850 to 900°F range and is favored by low residence time and increased steam rates. The liquid product distillation results suggest an increase in lower boiling liquids as a result of coking. Bogging does not appear to limit fluid coker operability in the temperature range of interest, although sacrifices in feed rates may be required.

49377 (FE—2547-17) **HRI Coal. Phase II laboratory support for H-Coal Project. Monthly progress report No. 17, March 1978.** (Hydrocarbon Research, Inc., Lawrenceville, N.J. (USA). Research and Development Center). Apr 1978. Contract EF-77-C-01-2547. 26p. Dep. NTIS, MF A01.

Portions of document are illegible.

Process Development Unit modifications are in progress to simulate as closely as possible the Pilot Plant design and to increase reliability and productivity. The central control room is nearly finished. It will house the data acquisition, storage and handling system which is scheduled for delivery the first week in April. Major equipment components for the antisolvent precipitation system are being received. Mechanical completion is targeted for late May. Fabrication of the two-stage letdown system will start in early April. Completion is scheduled for mid-May. Results from the catalyst evaluation bench unit program indicate that improved denitrogenation and desulfurization can be obtained from the nickel molybdate catalysts evaluated. Each of the two catalysts tested gave lower residual oil and higher distillate yields. The first run on Amocat 1A was aborted due to mechanical pump problems, but another run to test this catalyst has been started. The second Amoco catalyst, 1B, has been tested and initial results indicate a higher level of conversion and a shift in distillate yield to the 400 to 975°F fraction.

49378 **Chromatographic separation of coal liquids.** Cogswell, T.E.; Latham, D.R. (Laramie Energy Res Cent, Wyo). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 2, 58-66(1978). (CONF-780305—).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

A Synthoil coal liquid that had not been solvent deasphaltened was separated into fractions of acids, bases, neutral nitrogen compounds, satureated hydrocarbons, and aromatic hydrocarbons using ion exchange, coordination, and adsorption chromatography. The separation method is reproducible, and recovery of material was better than 95 percent. The method separates compounds according to chemical functionality and generates fractions that are suitable for detailed characterization. The Synthoil coal liquid used in this investigation contains about 30 percent acids and 20 percent bases, according to the ion exchange resin definition of acids and bases. The acids were characterized as being about 85 percent phenolic compounds and 15 percent compounds containing pyrrolic nitrogen. The bases were found to be largely pyridine and pyrrolic nitrogen compound types. The saturated hydrocarbons were 11 percent of the total coal liquid, and the aromatic hydrocarbons were about 24 percent. The average molecular weight of the coal liquid sample was determined by low resolution mass spectrometry to be about 225. 6 refs.

49379 **Process for upgrading solids-containing liquid hydrocarbon oils.** McIlvried, H.G.; Montagna, A.A. (to Gulf Research and Development Co.). US Patent 4,086,158. 25 Apr 1978. Filed date 24 Sep 1976. 10p.

A process is provided for the upgrading of solids-containing liquid hydrocarbon oils derived from coal, oil shale, and tar sands. The process comprises passing the solids-containing liquid hydrocarbon oil, together with hydrogen, through the void spaces of a fixed catalyst bed wherein the total void volume is within defined critical limits.

49380 **Coal-liquefaction products from major demonstration processes. I. Separation and analysis.** Schwager, I.; Yen, T.F. *Fuel;* **57**: No. 2, 100-104(Feb 1978).

Coal liquids from five major processes: Synthoil, HRI H-Coal, FMC-COED, PAMCO SRC, and Catalytic Inc. SRC have been separated reproducibly, in high yields (94 to 99 percent), into five fractions by solvent fractionation. The coal liquids are first separated into three fractions: pentane-soluble; pentane-insoluble and benzene-soluble (crude asphaltene); and benzene-insoluble. The pentane-soluble fraction is further separated into a liquid propane-soluble fraction (oil), and a liquid propane-insoluble fraction (resin). The benzene-insoluble fraction is further separated into a carbon disulphide-soluble fraction (carbene), and carbon disulphide-insoluble fraction carboid.

49381 **Dependence of coal liquefaction behavior on coal characteristics. III. Statistical correlations of conversion in coal-tetralin interactions.** Abdel-Baset, M.B.; Yarzab, R.F.; Given, P.H. *Fuel;* **57**: No. 2, 89-94(Feb 1978).

The liquefaction behavior of coals can vary over a wide range depending on both their chemical and petrographic characteristics. Sixty-eight coals have been studied under standard liquefaction conditions, in the presence of tetralin but with no added catalyst or molecular hydrogen. Simple correlations between conversion and individual coal parameters proved unsatisfactory. A novel approach utilizing a stepwise multiple regression analysis led to a number of linear equations relating conversion simultaneously to several coal characteristics. Such linear equations provide a basis for accurately predicting liquefaction behavior and confirm that wise selection of appropriate feedstocks will have an important economic value. It seems permissible to infer that the behavior of coals in any processing conditions can only be adequately accounted for by consideration of at least three coal properties; attempts to correlate coal

properties solely with a rank parameter, such as carbon content, can no longer be considered adequate.

49382 Mathematical modelling of the production of liquid products from coal. Gagarin, S.G. *Khim. Tverd. Topl.;* No. 2, 3-9(Mar 1977). (In Russian).

A general mathematical model has been evolved which describes the production of liquids from coal by hydrogenation in the presence of various quantities of oil products. The model is based on a regression equation which links the process parameters at the stages of hydrogenation, hydro-scrubbing and hydrocracking. Optimality criteria are formulated, and the optimum conditions are determined for maximising the yield of boiler fuels or of motor fuels. A relationship is established between process conditions and the quanitity of petroleum involved in the manufacturing process.

49383 Integrating analytical techniques with coal research. Jewell, D.M. (Gulf Research and Development Co., Pittsburgh, Pa. (USA)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 268-282(1977).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Current research efforts are being made to develop new processes for converting coals to more convenient forms, such as gas or liquids. Irrespective of specific approaches being explored, a common need exists to develop and apply analytical techniques which will provide useful structural information on feed coals, and products formed during conversion reactions. The techniques needed must be capable of providing accurate analytical data in a reasonable time for a variety of calculations. The same techniques should be flexible and capable of providing additional structural parameters when needed. A 'compositional mapping' philosophy will be discussed and demonstrated for coal liquefaction processes with emphasis placed on a) separation methodology, b) spectroscopic (^{13}CNMR) technology and c) structural correlations using (a) and (b). Separation techniques employ filtration, solvent extraction and SARA chromatographic methods in specific sequence such that predictive and structurally discrete fractions are obtained. By applying carbon NMR (and other) spectroscopic techniques to the specific fractions thus obtained, detailed structural information can be obtained. This approach permits the calculation of 'transferrable hydrogen' as well as other 'average parameters'.

49384 Economic efficiency of three synthetic fuel processes. Green, E.K. Lexington, KY; Univ. of Kentucky (1977). 104p. University Microfilms Order No. 77-23,506.

Thesis (Ph. D.).

Three coal based synthetic fuel processes, H-Coal, COED, and COG were selected for analysis to determine the economic efficiency of each process. The coal requirements of a plant capable of producing 100,000 barrels/day of synthetic crude (using any of the processes) were found to be large relative to any coal producing area; this could cause the price of coal to rise. The production function of each process was determined to be characterized by fixed proportions. Although each process produces synthetic oil and gas from coal, each has a unique input and output set; therefore, none of the processes could be ascertained technologically inefficient. To determine the economic feasibility of these synthetic fuel processes, a capital investment model was constructed which calculated the minimum synthetic fuel prices that would generate revenues sufficient to cover all costs given a cost of capital. Based upon the 1974 input and output price set, none of the processes could produce synthetic fuels with minimum prices competitive to the prices of natural fuels. Next, the price of coal, the price of natural gas (considered a by-product), capacity output, and the cost of capital were varied to show the effect of each on the price of synthetic crude. Given 1974 prices, lowering the depreciation time period and increasing the investment tax credit were found to be insufficient in lowering the price of synthetic crude to a level competitive with the price of O.P.E.C. oil. The role of coal based synthetic fuel processes will depend on the price competitiveness of synthetic fuels and/or on whether the United States government pursues a policy of energy independence. If synthetic fuels are produced, to minimize energy loss they should be used as primary sources of energy (such as home heating fuel, gasoline, etc.) and not for generating electricity.

49385 Procedure for hydrocracking hydrocarbons. Oettinger, W.; Saum, W.; Seubert, R. (to BASF A.G., Ludwigshafen am Rhein (Germany, F.R.)). German(FRG) Patent 1,645,711/B/. 10 Jun 1976. 4p. (In German).

A method for the hydrocracking of carbons to produce low-boiling hydrocarbons especially in the benzine and diesel oil field. The method uses carrier catalysts containing hydrating metals of the 5th and/or 6th subgroup and/or 8th group of the periodic system as well as crystalline zeolites in a matrix of oxides of metals of the main groups II, III or IV or mixtures of these oxides.

PYROLYSIS AND CRACKING

49386 (UCRL—52456) **Mechanical theory for drying of porous media.** Lyczkowski, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Apr 1978. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

The basis of a rational phenomenological theory for drying of porous media is derived for a single equivalent drying pore by applying two-fluid, two-phase flow theory. Simplifications are made to compare with other theories and models proposed or assumed in the literature to assess their correctness. The derivation illustrates the rational way bulk motion is introduced within the porous matrix. Explicit expressions are also obtained for the evaporation rate and phase permeabilities. The extension to a global drying model is made. A solution procedure for a simplified version of the model is outlined and an estimate of the coal semi-coking zone is provided by solving an analytical solution for another simplified model.

49387 Pyrolysis behavior of coals. Biryukov, U.V. *Freiberg. Forschungsh., A;* **558**: 21-27(1976).

Paper summarises work carried out at Kharkov Polytechnical Institute and published earlier in Soviet journals. It has been found that a knowledge of the percentage of liquid and mobile products of hard coals makes it possible to describe the structure of the coal, the pyrolysis process, and the coking properties of coals or mixtures of coals, and to predict coke strength and the degree of oxidation of the coals.

SOLVENT EXTRACTION

49388 Reaction analysis - a new principle in coal tar pitch and coal extract research. Bluemer, G.P.; Zander, M. (Ruetgerswerke A.G., Castrop-Rauxel (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 235-251(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

'Reaction analysis' means the application of chemical reactions in the analysis of coal-derived products (hard coal tar pitch, technical coal extracts). Reaction analysis is a statistical structure group analysis, since such chemical reactions are used only, that allow the determination of structure types and/or bonding types. The kind of information that can be obtained completes the information obtained by spectroscopical statistical methods. Some examples will be discussed in detail: the application of dehydrogenation with diphenylpicrylhydracyl or chloranil respectively, hydrogenation with zinc/pyridine/acetic acid, Diels-Alder-reaction with maleic anhydride, thermolysis and the formation of molecular complexes to hard coal tar pitch and coal extracts. The structural informations obtained will be presented in detail.

49389 Chemical nature of supercritical-gas extracts of coal and lignite. Bartle, K.D. (Leeds Univ. (UK). Dept. of Physical Chemistry). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 252-267(1977).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Materials extracted by compressed supercritical toluene and amounting to as much as 47.5% of a British bituminous coal and two Turkish lignites were separated into fractions and characterized by a range of spectroscopic and chromatographic methods. Average structures of the aromatic fractions were determined from schemes based on ^{1}H and ^{13}CNMR, and IR spectra. A toluene extract from a British coal is composed of mainly open-chain polynuclear aromatic average structures, with about 33% of the available sites carrying alkyl substituents. A gas extract obtained from the same coal in the presence H_2 and $ZnCl_2$ consists of generally smaller molecules incorporating more naphtenic substituents on small aromatic clusters. Fractions of gas extracts may have comparable average structures with more oxygen substituents.

BY-PRODUCTS

49390 Progress and trends in the production of chemical raw materials from petroleum, natural gas and coal. Griesbaum, K. (Karlsruhe Univ. (TH) (Germany, F.R.). Engler-Bunte-Institut). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 48-70(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Progress and trends in the production of chemical raw materials from petroleum, natural gas and coal. - Decreasing availability and increasing prices for ethane, propane and naphtha, the optimum feedstocks for the better utilization of petroleum, natural gas and

coal in the chemicals sector. The following developments are underway or shaping up: Improvements in the yields of chemical raw materials from the thermal cracking of conventional feedstocks, extension of the cracking processes to higher feedstocks all the way to crude oil, conservation of chemical raw materials by the application of more selective secondary conversion steps, and the selective conversion of coal into chemical raw materials. These developments as well as possibilities for the utilization of excess- and by-products from the manufacturing of chemical raw materials are described at typical examples.

49391 Mathematical model study of carbon disulfide column performance. Pustovoitenko, A.I.; Skripnik, E.A. *Coke Chem., USSR (Engl. Transl.);* No. 7, 39-42(1976).

Translated from Koks Khim.; No. 7, 32-35(1976).

Mathematical simulation offers an effective means of exploring the possibilities for improving column performance by clarifying the effects of numerous interrelated variables and determining the plate-by-plate variations in feedstock temperature and composition. The results obtained by studying CS_2 column performance on a mathematical model agree closely with practical operating data. They show that 6-7 equilibrium plates are needed in the concentrating section for isolating a CS_2 fraction at the specified distillate yield ratio with 20-28 plates in the column. The operating conditions are sensitive to variations in the distillate-components contents of the feedstock, but not to the bottoms-components concentration. Although much experience has been gained in the operation of carbon disulfide columns, the problems of attaining a high degree of CS_2 removal from the bottom product and forming a highly concentrated CS_2 fraction (SUF) are still awaiting urgent solution.

PROPERTIES

REFER ALSO TO CITATION(S) 49360, 49365, 49371, 49383, 49387, 49437, 49509

49392 (FE—2030-TR8) **Reactivity of heat treated chars.** Mahajan, O.P.; Walker, P.L. Jr. (Pennsylvania State Univ., University Park (USA). Coal Research Section). 1977. Contract EX-76-C-01-2030. 51p. Dep. NTIS, PC A04/MF A01.

Reactivities of a number of chars produced from American coals varying in rank from lignite to anthracite have been measured in air, CO_2, steam and H_2. The variables chosen for the study were: rank of the parent coal, inorganic matter content, particle size, reaction temperature and pressure as well as heat treatment conditions used during char preparation. In all gasification atmospheres studied, reactivity plots for different chars are essentially of the same general shape and have three distinct regions. The reaction rate first increases slowly with time. The plot then goes through a maximum in slope, followed by a lengthy region of decreasing slope as burn-off approaches 100 percent. The shape of the burn-off curves can be explained on the basis of what is known about the development of porosity and surface area in microporous chars as they undergo gasification. Using an adjustable time parameter, equations have been developed which successfully correlate the reactivity data. Char reactivity decreases, in general, with increase in rank of the parent coal. Reactivities of chars in air, CO_2 and steam increase over 150-fold in going from a low volatile bituminous to a lignite parent coal; the spread in char reactivities in H_2 is only 30-fold. Removal of inorganic matter from coal precursors prior to their charring or from chars produced from the raw coals has a marked effect on char reactivity and surface area. Removal of inorganic matter (by acid washing) decreases, in general, reactivity of chars produced from lower rank coals, whereas reactivities of chars derived from higher rank coals increase.

49393 (FE—2537-5) **Characterization of coal-derived liquids and other fossil fuel related materials employing mass spectrometry. Quarterly report, September 29, 1977—December 29, 1977.** Scheppele, S.E. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry). 16 Jan 1978. Contract EX-76-S-01-2537. 15p. Dep. NTIS, PC A02/MF A01.

The Data General RJE80 software has been implemented and communications were established between the Nova 3/12 minicomputer in the mass spectrometer laboratory and the IBM 370/158 computer in the campus Computer Center. To date, the communications line has been used to significantly expedite the Z-series analysis of high-resolution mass spectral data recovered from photographic plates. A program has also been written which extracts high-resolution mass spectral data, acquired directly from the mass spectrometer by the DS-50S data system, from disc in the Nova 3/12 and prepares it for remote job entry to the IBM 370/158 for Z-series analysis. This program also significantly facilitates data analysis by eliminating tedious key-punch work. Performance of the CEC 21-110B mass spectrometer and the DS-50S data system combination has been optimized for quantitative analysis. Design of the interface between the Nova 3/12 and the comparator/microdensitometer is progressing. Detailed investigation identified electrical problems preventing the attainment of optimum performance of the mass spectrometer/data system combination. The Department of Chemistry provided funds to eliminate these problems and corrective action is nearly complete.

49394 Pressure retardation of vitrinite diagenesis, offshore northwest Europe. McTavish, R.A. *Nature (London);* **271**: No. 5646, 648-650(16 Feb 1978).

Physio-chemical processes which increase coal rank also increase vitrinite reflectance, or the level of vitrinite diagenesis. The principal physical factors controlling these processes are geothermal gradient, thermal conductivity of lithological section, duration of heating, and pressure. The role of pressure has been considered negligible, but it is shown that retardation of vitrinite diagenesis by abnormally high formation pressure is both significant and predictable. The time factor seems to be of little significance on a geological scale.

49395 Fourier transform infrared study of acid-demineralized coal. Painter, P.C. *Fuel;* **57**: No. 2, 125-126(Feb 1978).

When the infrared spectrum of a demineralized coal is subtracted from that of the whole coal, the difference is characteristic of the minerals removed. Comparison of the difference spectrum with that of the low temperature ash of the same coal shows that calcium sulphate is formed during the low temperature ashing process for Illinois No. 6 coal. Unless the mineral content of a coal is high, a more accurate analysis can be obtained by analyzing the low temperature ash and using acid demineralization to ascertain the degree of conversion of mineral species during ashing.

49396 Coal-derived product effects on viscosity. Thomas, M.G.; Granoff, B. *Fuel;* **57**: No. 2, 122-123(Feb 1978).

A West Virginia coal was liquefied in the laboratory and the viscosity of the filtered liquid product was measured. It was found that preasphaltenes have a much more pronounced incremental effect on viscosity than do asphaltenes. Preliminary results of tests on other US coals support this conclusion.

49397 Nature of hydrogen bonding in coal-derived asphaltenes. Taylor, S.R.; Li, N.C. *Fuel;* **57**: No. 2, 117-121(Feb 1978).

Reports are presented on near-infrared and proton magneti resonance studies of hydrogen bonding between the hydroxyl group of o-phenylphenol (OPP) and two coal derived asphaltenes, and their acid and base components. The asphaltenes were prepared from bituminous coal under the same conditions except that one was prepared using a CoMo catalyst. The results of the studies show that the use of the CoMo catalyst leads to a base asphaltene component of lower molecular weight and higher hydrogen-bond acceptor strength.

49398 Characterisation of coal-liquefaction products by molecular-weight profiles produced by field-ionization mass spectrometry. Anbar, M.; St. John, G.A. *Fuel;* **57**: No. 2, 105-110(Feb 1978).

Field-ionization mass spectrometry, which produces fragmentation-free mass spectra, is being applied to the analysis of coal-liquefaction products. Using a new highly efficient and sturdy field-ionization source, samples of various coal-liquefaction products have been successfully analysed and their molecular-weight profiles determined by the integrating multiscan technique. The range of applications of this novel analytical technique to research and development of coal-liquefaction processes is discussed.

49399 Re-examination of the phenolic hydroxyl contents of coals. Abdel-Baset, Z. *Fuel;* **57**: No. 2, 95-99(Feb 1978).

In connection with studies of the dependence of liquefaction behavior on coal characteristics, parameters were needed that might effectively characterize the organic chemical structures. Accordingly, the phenolic hydroxyl contents of 37 coals from three geological provinces of the USA have been determined, by acetylation with ^{14}C labeled acetic anhydride. The results, when expressed as fractions of the total organic matter in the coals, showed a good inverse correlation with the carbon contents (dmmf). However, application of a stepwise multiple regression analysis to the data developed a linear equation relating hydroxyl content to the vitrinite reflectance, calorific value and vitrinite content, the fraction of variance explained being 92 percent. When the hydroxyl contents were expressed in the alternative manner, as fractions of the total oxygen content, no correlation could be seen with carbon content. However, in the wide scatter of points on the graph, the data are seen to fall into three reasonably distinct populations such that at the same level of rank, hydroxyl contents typically decrease for coals from the three provinces in the order Interior-Eastern-Rocky Mountain, implying that coals from these areas differ in structure as a result of differing antecedents. Statistical analyses showed that OH/O has

some significance in determining liquefaction behavior, but it is not among the coal properties found most significant.

49400 Micrinite and exudatinite in some Australian coals, and their relation to the generation of petroleum. Shibaoka, M. *Fuel;* **57**: No. 2, 73-78(Feb 1978).

The occurrence and microscopic features of micrinite and exudatinite in some Australian coals are reported. The origin of these macerals and also the significance of their occurrence are discussed in connection with hydrocarbon genesis. In Australia, micrinite occurs in bituminous and sub-bituminous coals which are very rich in inertinite, and also in brown coal rich in inertinite. One of the possible progenitors of micrinite is oxidized porigelinite. There is little reason to conclude that micrinite was formed from resinite and other macerals at an early stage of coalification and that liquid hydrocarbons were formed during this process. Exudatinite occurs in sub-bituminous and high-volatile bituminous coals in the Gippsland Basin. There is no positive evidence of a genetic relation between liquid hydrocarbons, exudatinite, micrinite and liptinite macerals. The formation of liquid hydrocarbons from solid liptinite etc., may take place just before and during Teichmuller's so-called 2nd coalification jump.

49401 Reduction gas from brown coal - an alternative for the iron and steel industry. Franke, F.H. *Braunkohle;* **30**: No. 1/2, 19-27(Jan 1978). (In German).

Based on the available processes for coal gasification, the coupling of brown coal gasification and iron ore reduction has been investigated in the form of one example of the utilisation of the high temperature Winkler gas generators at present in development. The high-temperature Winkler process is favoured for the production of reduction gas. Such an installation can generate a suitable reduction gas 'in one heating'. This high-temperature process has been tested both in the laboratory and on a large scale. Laboratory tests were carried out on the high-temperature process. The large scale test unit, which is to be put into operation at the turn of the year 1977/78, is described. Although economical production of reduction gas from coal still cannot be expected at present with the conventional gasification processes according to the knowledge available, this combination of brown coal gasification with gas shaft reduction will become competitive when the reduction gas produced can be used immediately in the shaft. The first mass and energy calculations are being made to ensure balanced coupling of gas generators and direct reduction shaft furnaces. The economical employment of reduction gas from coal in blast furnaces cannot be even thought of at present.

49402 Determination of optimal quantities concerning coal quality data. Filippov, W.M.; Vider, M.A.; Ridel, R.J. *Ugol;* **10**: No. 619, 59-65(Oct 1977).

In order to optimize the parameters of items that are to be standardized, the factors permitting the most effective usage of national economic resources have to be established i.e., the maximal satisfaction of demands providing the highest profit rate or the lowest production expenditure. The calculations specified in the paper lead to the following conclusions: the values of coal quality data should be technically feasible and optimal from a rational economic viewpoint. In order to optimize coal quality data a calculation method can be employed that is based on the choice of a variant entailing minimum incurrence of losses in output, processing, transportation and usage by the consumer. Calculations carried out to determine the optimal quantities of ash contents of coal, call for drawing up a list of standards, introduction of which will lead to economic expenditures for 1 kWh of input electrical energy.

49403 Thermooxidative deactivation of carbonaceous materials. Kiselev, Ya.S.; Abramov, A.S. *J. Appl. Chem. USSR (Engl. Transl.);* **50**: No. 10, 2149-2153(Oct 1977).

Translated from Zh. Prikl. Khim.; 50: No. 10, 2243-2247(Oct 1977).

The low-temperature oxidation of carbon blacks is characterized by a low value for the activation energy of the oxidation reaction, as a result of the presence of highly active centers on the surface of carbonaceous materials, rather than because the reaction takes place in the diffusion region. Such centers may be carbon atoms with unpaired valence electrons or with overly stressed bonds. The decrease in the absolute value of the rate and the increase in the temperature coefficient of the sorption rate during the oxidation of carbon surfaces may be caused by the successive exclusion of active centers from the oxidation reaction during chemisorption, rather than the formation of a continuous oxycarbon layer. The maintenance of the reactivity of coals during liquid-phase oxidation and the increase in the reactivity of carbon blacks following moistening may be attributed to the fact that in aqueous media the lactones are converted into carboxyls, which are then easily decarboxylated to form gaseous oxides, this process being accompanied by the generation and regeneration of active centers.

49404 Gamma radiation breakdown of sulphonated coal. Sharafutdinov, R.B.; Khodyrev, B.N. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 8, 26-28(Aug 1977).

Translated from Teploenergetika; 23: No. 8, 44-46(1976).

The higher the dose of irradiation of sulphonated coal in water the greater the oxidizability of the aqueous extract and the content of sulpho-groups with no alteration in the exchange capacity of the filtering material, which is evidence of the decomposition of the aliphatic sulpho-compounds and their transfer into solution. The infrared spectra obtained confirm this assumption. The independence of the exchange capacity of the sulphonated coal on the dose of irradiation (in the range investigated) shows that the sulpho-aromatic compounds, mainly involved in the ion exchange processes, undergo no marked alterations with doses up to 54 Mrad. To resolve the question concerning the feasibility of using sulphonated coal in the prefilters of condensate polishing plants in nuclear power stations with channel type uranium—graphite boiling reactors, it is necessary to investigate the influence of the products of decomposition on the exchange capacity of the charge of the mixed bed filters, and to seek methods for prior removal of the sulphonated aliphatic compounds from the filtering material.

49405 Adsorption mechanism of surfactants on coal. Basenkova, V.L.; Zubkova, Yu.N. *Khim. Tverd. Topl.;* No. 2, 137-140(Mar 1977). (In Russian).

The adsorption of surfactants of coals of varius ranks was studied. The effect of treating the coal with hydrochloric and nitrous acids is reported, and brief notes are given on the orientation of the surfactant molecules on the coal surface.

49406 Absorption of hexyl alcohol and hexanoic acid on the microcomponents of oxidized fat coal. Butuzova, L.F.; Kucher, R.V. *Khim. Tverd. Topl.;* No. 2, 119-125(Mar 1977). (In Russian).

A Donbass fat coal is used to show that sequential change in the oxygen-containing group content during oxidation at 150 C forms part of the general macroscopic series of changes involved in the oxidation of hydrocarbons by atmospheric oxygen. The adsorptive capacity of coal in regard to surfactants depends on the petrographic composition and the degree of oxidation. Change of adsorptive capacity during oxidation is related strictly to any change in the content of active, oxygen-containing groups on the coal surface.

49407 Water adsorption by fossil-fuel studied by nmr. Alekseev, A.D. *Khim. Tverd. Topl.;* No. 2, 94-97(Mar 1977). (In Russian).

The reaction energy of adsorbed water in anthracite is 3 to 4 times higher than in other coals. An adsorbed molecule of water is deformed over an inter-proton distance of up to 1.59A in anthracites. Water adsorption and transfer by diffusion processes in coal are dependent on the aliphatic carbon content, which diminished from 0.25 to 0.02 for coals with volatile matter contents of 15 to 20% down to 5%.

49408 Chromatographic analysis of extracts and pyrolysis products of Central Asian hard coal. Urmet, E.A. *Khim. Tverd. Topl.;* No. 2, 78-83(Mar 1977). (In Russian).

The group composition of methanol-benzene and ester extracts and pyrolysis products of Central Asian coal were determined. The hydrocarbon content fluctuates between 24 and 40%. The aliphatic hydrocarbons found included N- and iso- paraffins, isoprenoidal structure and traces of olefins. Bi- and tri-cyclical hydrocarbons were also found.

49409 Bitumoids (bitumens) of vitrains of the metamorphic series of coals from the Donbass. Polovnikova, I.A. *Khim. Tverd. Topl.;* No. 2, 37-45(Mar 1977). (In Russian).

The aromaticity of the bitumoids of type A vitrain, in brown coals, and long flame gas coals up to and including lean coals, is greater than that of the bitumoids of Type B vitrain, in coals of other ranks up to and including coking coals. In higher rank coals, bitumoids in both types of vitrain show increasing enrichment in CH, CH2 and CH3 groups, compared with a lower aromatic content and the presence of carboxylic groups. Changes in the quantity of bitumoids in type B vitrain show two peaks: in the gas coals and in coking coals. These changes are associated with changes in the oil yield, benzenes, asphaltenes, and the carbon/hydrogen ratio.

49410 Origin of germanium mineralization and rational ways of burning high germanium coal. Ratyinskii, E.M. *Khim. Tverd. Topl.;* No. 2, 29-36(Mar 1977). (In Russian).

The regions where germanium-bearing coal may be found are described. Information is given on the removal of germanium-rich concentrate from power fuels. Comparison of methods of burning power fuels in industrial boilers shows that coals with a high germanium content should be burnt in layer and layer-burner firing systems.

49411 Research into coal and the solid heat-process residue using infrared spectroscopy. Kekin, N.A.; Gamazina, A. *Khim. Tverd. Topl.;* No. 2, 10-15(Mar 1977). (In Russian).

Paper describes a new method of studying the change in functional groups in coal substances as a function of temperature. The saturation band intensity is measured in infrared spectra during continuous heating of the coal.

49412 Chemical structure and behaviour of hard coal. A survey from an analytical point of view. Oelert, H.H. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Chemische Technologie und Brennstofftechnik). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 216-234(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Research work on bituminous coal during the past decade is reviewed under the aspects of heterogenous, solid multicomponent mixture, elemental analysis, thermal behaviour and decomposition, thermodynamic effects, solubilities, spectroscopic investigations.

49413 Ash monitoring on coal conveyors, using forward-scattered gamma rays. Onishchenko, A.M.; Vasil'ev, A.G.; Slavinskii, V.M.; Kuznetsova, A.I. *Coke Chem., USSR (Engl. Transl.);* No. 11, 11-14(1976).

Translated from Koks Khim.; No. 11, 9-12(1976).

An americium^{241} source is used to monitor the ash of coals in motion. The readings are influenced by the bed depth, moisture and iron present in the coals. An absolute error limit of 0.26% ash can be maintained over rangs of +- 25% about the average bed depth, +- 0.5% for moisture and +- 0.05% for iron.

49414 What should an industrial classification of Soviet coals comprise. Fishberg, V.D. *Coke Chem., USSR (Engl. Transl.);* No. 9, 5-10(1976).

This paper discusses the classification scheme for Soviet industrial coals proposed by Ammosov and Eremin; in this scheme coals would be classified on their noncaking content and vitrinite reflectance. However, it is considered that a classification would be best based on technological indices, e.g., the volatile matter and plastic layer thickness.

49415 Microbiological activity in relation to coal utilisation. Part I. Background. Ponsford, A.P. *Br. Coal Util. Res. Assoc., Mon. Bull.;* **30**: No. 1, 1-18(Jan 1966).

Part I of the review deals with the necessary background of microbiological reactions and their applications. Speculations on the possibility of micro-organisms bringing about particular chemical reactions could be misleading if based on the case of effecting chemical reactions in the laboratory. The elaborate enzyme systems possessed by living micro-organisms enable them to effect at ordinary temperatures reactions that are difficult or impossible by chemical means, even with the aid of catalysts or of high temperatures. However, in surveying the possible utility of coal as a substrate for microbial growth it is useful to keep in mind the types of chemical change required if parts or all of the carbon structure present are to be assimilated by micro-organisms. The main need is to find micro-organisms that are able to open up aromatic and hydroaromatic rings and break down further the substances formed into simpler compounds that can be metabolized. Coal is fairly readily broken down by chemical oxidative methods. It is possible therefore that oxidative breakdown of a similar type might be achieved by microbial enzymes. Alternatively some reduction might be effected. The remarkable versatility of microbial cells in being able to carry out rapidly by means of enzyme systems complicated chemical changes of diverse type, in strong contrast to the protracted or drastic measures employed by the organic chemist to effect similar changes, is striking. In common with other catalysts, enzymes are regenerated unchanged after each transformation. Many biochemical changes require the operation in sequence of several different enzymes. In addition, many enzymes require the presence of co-enzymes—organic compounds within the cell which act as carriers of hydrogen, phosphate, etc.

49416 Analytische Methoden fuer die Untersuchung von Ferngas. Koksofengas, Raffinerie-Spaltgas, Erdgas. (Analytical methods for the investigation of piped gas. Coke-oven gas, refinery fission gas, natural gas). Seebaum, H.; Wiencke, K. (comps.). Essen, Germany, F.R.; Vulkan-Verl. (1966). 201p. (In German).

The book contains a collection of investigation methods for controlling the gas quality in a gas piping system. The analysis methods for coke-oven gas, refinery fission gas and natural gas (gas additions, gas composition, combustion properties) are described in various chapters. The working regulations are clearly given and accompanied by sketches of the principles as well as supplemented by practical calculation examples. The clear definition of sample taking is of particular importance and is treated in a chapter of its own.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 49415, 49430, 49450, 49509, 49524, 49973, 50759

49417 Ash importance to increase in coming months. *Ash at Work;* **9**: No. 6, 1-2(1977).

A recent survey by the National Coal Association shows that a quarter of the new coal-fired steam generating stations are to be built in the south west of the US. These areas will thus have available commercial amounts of local fly ash which can be used as construction materials.

49418 Waste gas desulphurization from a biological point of view. Berge, H.; Orgis, K. (Institut fuer Umweltschutz und Agrikulturchemie, Heilighaus (Germany, F.R.)). *VGB Kraftwerkstech.;* **58**: No. 2, 108-110(Feb 1978). (In German).

Although there is an increasing pressure for the installation of flue gas desulphurization systems in power plants today, one should first make an assessment of the sites. In densely populated areas, further SO_2 emissions are undesirable now that the immission situation has been improved so far that only very few regions may still be called polluted. The case is quite different with, e.g., conventional power plants at some distance from densely populated areas. Here, the difference between washout and sulphur supply due to precipitation is particularly dramatic.

49419 Sampling, analysis and characterization of effluents from the Grand Forks Energy Research Center's Slagging Fixed-Bed Gasifier. Paulson, L.E.; Schobert, H.H.; Ellman, R.C. (Grand Forks Energy Res Cent, ND). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 2, 107-118(1978). (CONF-780305—).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The Grand Forks Energy Research Center is operating a slagging, fixed-bed, coal gasification pilot plant. The pilot plant was previously operated from 1958 to 1965 to establish operability of the slagging method of ash discharge and to evaluate process parameters. Operation was resumed in April 1976 with the major objectives being to study the effluents produced in gasification. Methods currently used at GFERC to sample and analyze effluents are presented and results are related to gasifier operation. A flowsheet of the GFERC pilot plant is given. All tests described were performed with Indian Head lignite obtained from the North American Coal Company mine in Mercer County, ND. A typical analysis for as-gasified coal and the range of observed analyses is shown. Extensive analytical data are tabulated, plotted and evaluated. 9 refs.

49420 Aqueous effluents from the synthoil process. Akhtar, S.; Mazzocco, N.J.; Yavorsky, P.M. (Dep of Energy, Pittsburgh Energy Res Cent, Pa). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 2, 156-164(1978). (CONF-780305—).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Conversion of coal to an environmentally acceptable utility fuel is a high priority objective of the Department of Energy. Work on several processes designed to convert coal to a low-sulfur, low-ash liquid or solid fuel is in progress. One such process under development is the SYNTHOIL process using direct hydroliquefaction. A unit of $one-half$ ton of coal slurry per day capacity has been in operation for over three years, and a larger process development unit of 10 tons of coal per day capacity is under construction. The aqueous effluents from a conceptually integrated commercial SYNTHOIL plant are reviewed and the analytical results for the one aqueous effluent available from the existing $one-half$ ton per day SYNTHOIL unit are presented. It is pointed out in conclusion that aside from the maintenance discharges, there will be six aqueous effluents from a commercial SYNTHOIL plant. A review of these effluents shows gaps in knowledge which must be filled in order to design treatment facilities for the effluents. Several of these effluents, however, are not yet available. This paper presents only analytical results for a sour water effluent, obtained from a $one-half$ TPD SYNTHOIL unit. 11 refs.

49421 Biokinetics of activated sludge treatment of synthane fluidized bed gasification wastewaters. Neufeld, R.D.; Drummond, C.J.; Johnson, G.E. (US Dep of Energy, Pittsburgh Energy Res Cent, Pa). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 2, 175-186(1978). (CONF-780305—).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Data are presented on a normalized basis for key pollutant parameters from the SYNTHANE gasification of Montana Rosebud, Illinois ^{6}, and North Dakota lignite coals. Biological kinetic parameters, sludge production parameters, and oxygen utilization parameters are established for the activated sludge treatment of wastewater from the SYNTHANE gasification of Montana Rosebud coal.

About 12% of the TOC in the feed to biological reactors from Montana gasifier condensate is not biologically degradable. Based on experimental observations from the biological treatment of Montana Rosebud condensates, a one-stage aerobic biological reactor with sludge age of 10 days and hydraulic detention time of about 1 day is capable of treating SYNTHANE by-product wastewater. It is concluded that biological processing should have a major role in the water pollution abatement of SYNTHANE gasifier water, and is probably applicable to other first and second generation gasification wastewaters. Biological processing cannot, however, completely remove all organics from gasifier wastewater. 11 refs.

49422 Air pollution: flue gas desulfurization and technology transfer. Grefen, K. *Umwelt;* No. 6, 444-448(Dec 1977). (In German).

Flue gas desulfurization, already practiced in Japan and the USA, is investigated with a view to those boundary conditions which might be an obstacle to direct application in the FRG, or which might at least make application difficult. Apart from legislation and energy policies, the influencing parameters are type, quantity, and reserves of fuels, infrastructure, etc.

49423 Effect of leonardite on diffusion of phosphorus in coal mine spoils. Harrell, J.W. Jr.; Saeed, M. (Univ. of North Dakota, Grand Forks). *Soil Sci.;* **124**: No. 5, 285-290(Nov 1977).

Phosphorus diffusion coefficients (D) have been measured using ^{32}P in coal mine spoil from Glenharold, North Dakota, spoil with 10% leonardite, and in leonardite as functions of applied P, water-soluble P, and NH_4F-extractable P. In each case the D values are in the relative order spoil > spoil + 10% leonardite > leonardite, and are linear functions of the amount of P. The addition of 10% leonardite to the spoil substantially reduces D. In order to determine the effect of different sorption capacities on the measured D values, capacity factors have been determined and used to calculate porous medium diffusion coefficients (D/sub p/). The values of D/sub p/ are approximately the same for the spoil and the spoil with leonardite. This suggests that the reduction in D of the Glenharold spoil due to the presence of the leonardite can be almost entirely accounted for by the higher sorption capacity of the leonardite as compared to the spoil.

49424 Clear water at Silverdale Colliery. *Heat. Vent. Eng.;* **51**: No. 600, 26-28(Jul 1977).

The mine water treatment plant at Silverdale colliery is described.

49425 Method to process washing liquid preferably for flue gas-SO_2 washing plants. Hoelter, H.; Gresch, H. German(FRG) Patent 2,539,927/A/. 17 Mar 1977. 4p. (In German).

A method to process washing liquids preferably for the oxidation of impurities is described. In order to create a large area of contact between the washing liquid and air, the invention proposes to oxidize the washing liquid in the ultrasonic region with lime-containing materials and other additions and air or oxygen.

49426 Fire fighting at the Haveluy spoil heap. Dussart, L. *Publ. Tech. Charbon. Fr., Inf. Tech.;* No. 7, 357-376(1977). (In French).

Spontaneous heating at the Haveluy spoil heap could not be controlled by an anti-fire trench filled with clay. It was decided to inject inert substances through boreholes. The methods of injection of fly ash are described and the advantages of closely spaced boreholes injected from the top downwards are noted.

49427 Effect of depositing brown coal ash in abandoned opencast mines on the chemical content of the groundwater. Heide, G. *Z. Dtsch. Geol. Ges.;* **128**: No. 2, 349-359(1977). (In German).

Field tests and laboratory analysis showed a high content of soluble sulfates in the ash of brown coal, depending on the sulfur content of the coal. Several million tonnes a year of ash from power stations are deposited in worked-out opencast mines in the Rhine-Westphalia Basin. When mining is finished in the area, the groundwater level will rise and be in contact with the ash, and for a long period the sulfate content of this water will be of the order of 1000 mg/l. In order to avoid this, proposals for sealing the deposited ash are made.

49428 Coal ash: a potential mineral source. Wright, J.H.; Roffman, H.K. (Westinghouse Environmental Systems Dept., Pittsburgh). pp 163-173 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

More than 50 million tons of coal ash are produced annually by coal-fired power plants in the United States. This quantity will increase for two major reasons. First, although approximately 40% of the present U.S. electrical production is based on oil and natural gas, the unavailability and unreliability of these sources, in addition to their increased prices, will force many utilities to convert to coal. Second, the increased use of the U.S.'s western subbituminous coals that contain a relatively much greater quantity of ash than the eastern coals will substantially increase ash tonnage. Although an increase in coal ash production is to be expected, the utilization of this ash within the United States is still limited. As a result, more than 90% of the ash is disposed of as useless and represents a potential burden to the environment. Concurrently, the United States is facing a deterioration of its natural mineral supplies. Coal ash contains substantial concentrations of major elements such as aluminum and iron and significant concentrations of minor and trace elements such as germanium, gallium, selenium and uranium. These elements have the potential of being economically extracted from the ash. Therefore, the use of ash as a useful mineral source may offer a positive solution to the disposal problem. The same elements that are potentially hazardous to the environment can be removed from the ash for useful purposes, thereby eliminating the impact on the ecology.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 49350, 49426, 49427, 49523, 50995, 51039, 51040, 51051, 51082, 51292, 51327

49429 (ANL/AA—11(Vol.2)(Draft)) **National coal utilization assessment. An integrated assessment of increased coal use in the Midwest: impacts and constraints.** (Argonne National Lab., Ill. (USA)). Oct 1977. Contract W-31-109-ENG-38. 404p. Dep. NTIS, PC A18/MF A01.

This study was performed as a part of the Argonne National Laboratory Regional Studies program, which is sponsored by the Department of Energy. The purpose is to assess the impacts and consequences associated with alternative energy options on a regional basis, and to identify and analyze alternative mitigation and solution strategies for increasing the acceptability of these options. The National Coal Utilization Assessment is being conducted as a part of the Regional Studies Program. This particular study is focusing on impacts and constraints on increased coal utilization. In addition, a major focal point for the study is the identification and analysis of alternative solution strategies applicable to these constraints and problems.

49430 (COO—2727-6) **Contamination of groundwater by heavy metals from the land disposal of fly ash. Technical progress report, June 1, 1977—March 31, 1978.** Theis, T.L. (Notre Dame Univ., Ind. (USA). Dept. of Civil Engineering). Apr 1978. Contract EY-76-S-02-2727. 33p. Dep. NTIS MF A01.

Portions of document are illegible.

A study has been undertaken on a specific ponded fly ash disposal site to determine the degree of subsurface leaching of various ionic forms, especially heavy metals. The location is the site of the Michigan City generating station of the Northern Indiana Public Service Company, Michigan City, Indiana. The present ash ponding system consists of two primary ash ponds (volume of each 16.5 million gallons) which are loaded alternately, i.e., when one is in service the other is allowed to dry for the removal operation. The ash is sluiced to the ponds in a concentrated slurry. After primary and secondary settling the water is brought back for further ash sluicing. A constant elevation is maintained in the ponds at approximately 31.5 feet above the surface of Lake Michigan. The system cannot be considered closed because of losses due to evaporation and subsurface leaching. The station produces 340 to 400 tons of fly ash per day when operating at full capacity. A typical pond cycle requires six to nine months between removal periods. Observation wells were installed at various locations. Typically, the chemical composition of the groundwater varied with both time in the pond cycle as well as distance from the pond. Heavy metal concentrations decreased rapidly from the rather high levels found in the pond but a smaller peak concentration occurred some 100 meters from the pond after which the concentration decreased to rather low levels. The dominant mechanisms of attenuation are adsorption of metals onto hydrous oxides of iron and manganese and precipitation of various solid phases.

49431 (UCRL—52405) **Results of a groundwater quality study near an underground coal gasification experiment (Hoe Creek I).** Campbell, J.H.; Pellizzari, E.; Santor, S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Feb 1978. Contract W-7405-ENG-48. 121p. Dep. NTIS, PC A06/MF A01.

Groundwater sampling and analysis have been carried out at the site of an underground coal gasification experiment conducted by the Lawrence Livermore Laboratory near Gillette, Wyoming. Water from more than 12 wells in the vicinity of the experiment has been sampled before, during, and up to 10 months following gasification. Water samples were analyzed for a variety of characteristics, including the presence of 70 inorganic compounds and elements, phenolic materials, and volatile and semi-volatile organics. We find a

greatly increased concentration of organic materials, particularly phenols, just outside the burn boundary and a variety of inorganic species issuing from within the residual ash bed. All detectable contaminants rapidly decreased in concentration with distance, although above-background levels of some species were detected 100 ft from the burn zone. Several important contaminants showed a large decrease in concentration with time due, probably, to absorption. From these data a simple physical picture is generated of the time-development of groundwater pollution near an underground coal gasifier.

49432 Effects of underground coal gasification on ground-water quality. Campbell, J.H.; Dalton, V.; Busby, J. (Lawrence Livermore Lab, Calif). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 2, 95-106(1978). (CONF-780305—).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Although in-situ coal gasification offers important environmental advantages when compared with more conventional methods of coal recovery, there are certain environmental concerns that require careful evaluation. The possibility that underground reaction products may cause adverse changes in ground-water quality is particularly important. The Lawrence Livermore Laboratory (LLL) is pursuing a 3-part program to clarify the nature and significance of the ground-water question. This program includes a laboratory investigation of gasification reaction products and their interaction with coal, a modeling study of the evolving plume of contaminated ground-water, and a ground-water sampling program at the site of an in-situ coal gasification experiment. The gasification experiment was conducted in North-East Wyoming (the Hoe Creek site) by LLL. This paper is focused on the results of the water-sampling program associated with the "Hoe Creek I" gasification experiment and results from recent laboratory experiments on ash leaching and pollutant transport. Experimental data are tabulated, plotted and discussed. It is shown that phenolic materials are one of the major organic pollutants associated with in-situ coal gasification. Maximum levels of near 500 ppm have been measured in the groundwater. Transport of these materials away from the gasification site poses a potential long term pollution hazard. 10 refs.

49433 Modelling of small, localized surface subsidence. Fenk, J. *Neue Bergbautech.;* 7: No. 6, 414-417(Jun 1977). (In German).

The process of formation of localized subsidence holes in the surface was studied on a model, and the results are compared with a mathematical and statistical analysis of actual surface holes.

49434 Carbon dioxide-climate problem: recent developments. Pearman, G.I. *Clean Air (Brighton, Engl.);* **11**: 21-26(May 1977).

The causes of observed increases in carbon dioxide concentration in the atmosphere, and the possible climatic consequences if the trend is sustained, have direct relevance to the debate on future energy requirements and their environmental effects. On the basis of the recent literature and two international carbon dioxide-climate meetings scheduled for this year, several aspects of the global carbon cycle are discussed and the areas of uncertainty emphasized.

49435 Surface displacement resulting from rectangular panel extraction in level seams. Szetkowski, S. *Arch. Gorn.;* **21**: No. 3, 205-222(1976). (In Polish).

Formulas are given which describe surface movements caused by working of horizontal seams. Known formulas for horizontal movement and deformation and for the maximum movement are evaluated. Formulas are combined to make them suitable for use on computers.

49436 Fungi in and near streams carrying acid mine-drainage. Cooke, W.B. *Ohio J. Sci.;* **76**: No. 5, 231-240(1976).

From streams carrying acid mine-drainage and from adjacent soils in 3 areas in Ohio and West Virginia, 189 species of fungi, including yeast-like as well as filamentous types, were isolated using agar pour plates and shaken flask cultures. The more important members of this population were members of the Fungi Imperfecti, 25% of these yeast-like and the remainder filamentous.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 49394, 50476

49437 Differential thermal and thermogravimetric studies and some trace-element contents of some coals and carbonaceous shales from west-central Sinai, Egypt. Gindy, A.R.; El-Askary, M.A.; Khalil, S.O. (Alexandria Univ., Egypt). *Chem. Geol.;* **22**: No. 4, 267-283(Jun 1978).

DTA, modified DTA, thermogravimetric and spectrochemical analyses were performed on twelve samples of Carboniferous carbonaceous shales and coals and two samples of vitrain (separated from the carbonaceous shale or coal) in west-central Sinai. The analyses indicate that these coals and carbonaceous shales belong to the high-volatile sub-bituminous A coal-rank. Trace-element contents for Pb, Zn, Ga, B, Mn, Ge, Ni, V, Cr, Cu and U are given and averaged. These are then compared with the averages for the only published trace-element contents of the nearby Jurassic Ayun Musa coals. They are found to be richer in Pb, Zn and Ga. Ge is remarkably concentrated in the vitrain bands and seamlets inside the Carboniferous Sinai host-coals while V, Zn and Pb and, to a lesser extent, Mn, Cr and U are depleted in vitrains relative to their host-rocks.

49438 Hula Valley peat: review of chemical and geochemical aspects. Brenner, S.; Ikan, R.; Agron, N.A.; Nissenbaum, A. (Hebrew Univ., Jerusalem). *Soil Sci.;* **125**: No. 4, 226-232(Apr 1978).

In the Hula Valley, Israel, four layers of peat of Middle Pleistocene to Holocene age, interbedded with limnic clays and marls, are found above 300-m depth. The main detrital minerals are kaolinite, montmorillonite, and illite. Average elemental values of organic matter of dry peat are: C, 15-29 percent; H, 1.8-3 percent; N, 0.8-1.2 percent; S, 2.3-5 percent. The ash content (on dry basis) is 36-59 percent. The average calorific value ranges from 1670 to 3400 cal/g. Organic constituents isolated from the upper layer (Peat Horizon One) include: C_{12} to C_{26} fatty acids, β-sitosterol, β-sitostanol, friedelin and friedelanol, ceryl alcohol, a series of hydrocarbons, among them the polycyclic hydrocarbon, perylene, 13 amino acids and a series of polysaccharides of molecular weight in the range of 40,000. A detailed quantitative investigation of the distribution with depth in the top peat layer of the humic, fulvic, and hymatomelanic acids, as well as of the β-humus and humin, showed humin to be the dominant fraction of the organic matter. Its amount increases from 62 percent of the organic matter (by weight) at the surface to 70 to 90 percent at 2-m depth. The fulvic acid and polysaccharides show rapid decrease with depth, accompanied by concomitant increase in the β-humus. The humic acid increases with depth. Analysis of the peat organic fractions for carbon and hydrogen stable isotopes shows that with depth the difference in delta C^{13} between the humic and fulvic acids disappears and the delta C^{13} stabilizes at around -18 parts per thousand. The isotope data indicate the dynamic nature of the fulvic acid in the peat. The delta D values were around -60 parts per thousand, but the data are too meager for any firm conclusion.

49439 Development of world coal mining. Pugh, A. *Coal, Gold Base Miner. South. Afr.;* **26**: No. 4, 40-41, 43, 45, 47(Apr 1978).

The U.S.A. and Russia have approximately 45% of the total output of hard coal. When the figures of proven reserves are examined, the pattern of resources is somewhat different as the reserves in Russia are approximately double those in the U.S.A. They clearly indicate the need of the Western world to continue with energy conservation programmes and the strategic importance of energy resources. The figures are of course proven reserves. Obviously they are affected by the extent of the exploratory programme being carried out. Equally, this is affected by market supply and demand factors currently in force. New coalfields are being discovered. For example in the U.K. more workable reserves have been proven since the last war than have been worked in the same period. Considering the contribution which coal could make in the future to the world energy balance, it seems that the main potential for increased coal production lies with North America, the U.S.S.R. and The Peoples' Republic of China. There can be some additional production from Poland, Africa, India, U.K., Australia and some of the South American countries. These coal-producing areas could probably give additional annual production by 1982 of about 400 million tons.

49440 Distribution patterns and structural zonation of coal deposits of Central Kazakhstan. Marfutov, L.A.; Sokolov, O.G. *Int. Geol. Rev.;* **20**: No. 4, 396-406(Apr 1978).

Translated from Sov. Geol.: No. 2, 91-103(1977).

Results of investigations obtained during an analysis of the patterns of tectonic disturbance of the coal deposits in Central Kazakhstan are presented, which vary in time, conditions of formation, and tectonic complexity. The principal data defining the coal content and construction of the coal deposits in the various structural zones are presented tabularly. In projecting the geological-exploration works as a basis for measuring the exploration network and the optimum ratio of categories of reserves, the types of deposits recognized in the structural zones may conveniently be compared with the accepted grouping of the deposits on the basis of complexity. In structural zones I and II, the major portion of the reserves may be assigned to the run-of-the-mill category and only in individual, little disturbed blocks, to category C_1. In structural zones III and IV, there are the most favorable deposits based on the tectonic factor (simple brachyformal folds), which may be compared with group I, besides the near-fault sectors, assigned according to complexity of construction to groups II and III. During detailed exploration of the coal deposits occurring in these zones, reserves of

categories A and B must be recognized. The coal deposits of structural zone V (superimposed basins) are characterized by the significant manifestation of disjunctive faulting. Mainly, these deposits will be assigned to group II. For the deposits of this zone, recognition of reserves of category A is not required (individual, most disturbed deposits may even be assigned to group III in complexity).

49441 Electromagnetic technique of measuring coal layer thickness. Ellerbruch, D.A.; Belsher, D.R. (National Bureau of Standards, Boulder, CO). *IEEE Trans. Geosci. Electron.;* **GE-16**: No. 1, 126-133(Apr 1978).

An FM-CW microwave system was investigated for measuring coal layer thickness. Measurements were made in three mines near Pittsburgh, PA, Fairview, WV, and Coffeen, IL. Microwave frequencies in the range 1-2 GHz were used to measure samples up to 55-cm thick. All samples were backed with a naturally occurring shale. Measurements were also made on coal and shale samples compounded in the laboratory at the Bureau of Mines Pittsburgh Mining and Safety Research Center near Bruceton, PA. The results indicate that layer thickness can be determined in most cases, although large anomalies may, in some cases, produce misleading results. Many anomalies that were detected with the FM-CW system were verified visually by drilling into the coal layer. The dielectric constant of coal apparently varies significantly within a coal seam. It appears that this technique has the potential of measuring changes in the dielectric constant of a coal seam and providing an output that can be used for real-time corrections in layer thickness measurement.

49442 Plate tectonics and the formation of Britain. Dykes, J. *Colliery Guardian;* **226**: No. 2, 83, 85, 88(Feb 1978).

Paper describes how Britain was formed by the movement of plates, and how plate movements affected the formation of British coal deposits.

49443 Fossil fuels - their exploration and ensurance, illustrated by the example of the Federal Republic of Germany. Reiche, E. (Geologisches Landesamt Nordrhein-Westfalen, Krefeld (Germany, F.R.)). *VGB Kraftwerkstech.;* **58**: No. 1, 11-16(Jan 1978). (In German).

Although the Federal Republic of Germany must import yearly substantial quantities of fossil fuels,i.e. mineral oil and natural gas to cover the demand for energy she is nevertheless rich in other fossil fuels or - more precisly - in primary energy carriers. Here coal and lignite deposits are to be listed above all. In comparison with this, the natural gas deposits in the Federal Republic of Germany are of little significance as far as quantity is concerned, mineral oil reserves in the meantime are now even of secondary importance. The article deals therefore only with the coal and lignite deposits in the Federal Republic.

49444 Origin of coal basins by salt solution. Broughton, P.L. *Nature (London);* **270**: No. 5636, 420-423(1 Dec 1977).

Williston brown coal basin in North America is interpreted as an effect of regional solution of up to 150 m thickness of Devonian salt. The Late Cretaceous-Tertiary salt removal from the buried Elk Point Evaporate Basin has resulted in sufficient collapse subsidence to be structurally reflected in the overlying Palaeozoic and Mesozoic stratigraphic column. The Palaeocene coalfields are topset to late Cretaceous delta lobes developed within salt solution troughs.

49445 Stratigraphic drilling report: GSQ Taroom 10. Heywood, P.B. *Queensl. Gov. Min. J.;* **78**: No. 913, 565-573(Nov 1977).

Data from a borehole in the western Bowen Basin are reported. Significant thicknesses of coal are cored at depths of 100 to 350 m. At present the coal does not appear to be of commercial value.

49446 Principle cycles of formation of Triassic-Jurassic basins and the maxima of coal accumulation in central Iran. Polyanski, B.V. *Int. Geol. Rev.;* **19**: No. 9, 1031-1040(Sep 1977).

This paper considers the tectonic development, changes in thickness, and facies composition of the Triassic-Jurassic coal-bearing sediments in recognized structural-facies zones of central Iran. The Triassic-Jurassic sedimentary series is subdivided into four macrocycle complexes, corresponding to transgressive-regressive cycles of sedimentation. Four maxima of coal accumulation, consisting of coal-bearing horizons that contain the principal reserves of Iranian coal, are confined to the stable phases of the cycles.

49447 Departmental drilling in the Curragh area, north of Blackwater. Galligan, A.G. *Queensl. Gov. Min. J.;* **78**: No. 910, 365-374(Aug 1977).

A shallow drilling program in Central Queensland was carried out during 1976. The aim of the program was to evaluate coal reserves at shallow depths in seams of the Permian Rangal Coal Measures. Measured reserves of raw coal in situ comprise 179 million tons of which 54 million tons are suitable for use as coking coal. All the reserves are less than 55 m deep and are amenable to opencut mining. Although the coking coal is classified as low volatile, high rank, medium ash, low fluidity coal, a considerable variation in coking properties occurs due mainly to the difference in vitrinite content of the two major seams. The Aries-Castor seam is high in vitrinite and has a wider scope for use in the coking coal industry than the Pollux seam which has a low vitrinite content. The non-coking coal has a raw coal ash content of approximately 15% and high specific energy and would be suitable for power generation. Variable and generally low ash fusion temperatures of the non-coking coal may limit use of the coal in existing power stations.

49448 Coalification gradients in the Alpine foothills. Kuckelkorn, K. (Niedersaechsisches Landesamt fuer Bodenforschung, Hannover (Germany, F.R.)); Jacob, H. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 331-338(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Vitrinite reflection profiles from the Bavarian Molasse Basin and the underlaying Mesozoic sediments show that the coalification process took place mainly before the overthrusting by the subalpine folded part of the Molasse. Together with the subsidence of the basin, the isotherms also lowered. The low coalification gradients of the known autochthonous and allochthonous Series infer a degree of maturity, within the liquid window for lower tectonic units down to the lowest drillable depths.

49449 Well-logging techniques for mineral deposit evaluation: a review. Scott, J.H.; Tibbetts, B.L. Washington, DC; Bureau of Mines (1977). 45p.

Well-logging techniques that have been used to evaluate various types of mineral deposits are discussed briefly. Information is categorized by mineral commodity to make it easy to determine what logging techniques have been used for evaluating specific metals and nonmetals. Part 1 deals with metal deposits. Part 2 covers nonmetals including coal.

MINING

REFER ALSO TO CITATION(S) 49424, 49435, 49439, 49516, 49517, 49519, 49523, 49966, 50491, 50883

49450 Ash to correct subsidence. *Ash at Work;* **9**: No. 6, 3-4(1977).

The Williamson Shaft Contracting Company is to pump a fly-ash slurry into the abandoned Consol No. 26 Mine at Fairmount, W.Va., to prevent subsidence. This is a project of the US Bureau of Mines.

49451 Testing and assessment of materials liable to dust explosion or fire. Burgogne, J.H. *Chem. Ind. (London);* No. 3, 81-87(4 Feb 1978).

Paper describes the measurement of dust explosion parameters, and safety precautions which must be taken where a dust explosion is possible. The explosion hazard from various dusts may be expressed by rating it relative to the hazard from Pittsburgh coal, because a large amount of research has been done on this coal dust.

49452 High-powered conveyor systems: long distance, downhill, open-pit, and high capacity conveyors. Pelzer, H.K. *Min. Technol.;* **60**: No. 687, 20-26(Jan 1978).

Paper indicates the conditions under which belt conveyors are superior to other forms of transport, the limitations of these conveyors. Long distance, downhill, open-pit and high capacity conveyor installations are described, including a 60-mile long conveyor in the Sahara.

49453 Determination and evaluation of the explosability of mine fire gases. Mueller, R. *Glueckauf-Forschungsh.;* **38**: No. 6, 223-230(Dec 1977). (In German).

After a general view on the internationally known methods for the determination and evaluation of the explosiveness of colliery gases, the author points out F.J. Kock's ideal demands from such methods which have been fulfilled only partially until today. On the basis of Drekopf's method, the author develops a procedure which fulfills all ideal demands defined by F.J. Kock, independent of the quantity of the burnable gases in a colliery fire. He gives not only the possibility to take into consideration the effects of the changing fire air on its way from its source to the place where the sample is taken, but he also provides us with the possibility of making concrete tendency forecasts by giving a representation of the explosiveness of colliery gases. Furthermore formulae for determining the additional need in hydrogen are developed in order to bring the composition point of the fire gas to the lower or upper explosion limit which can be very important as information for the use of the inertisation

method with hydrogen. Finally the pocket calculator Texas Instruments TI 59 is programmed for the calculation of the characteristic values.

49454 10 year's experience with the cable belt conveyor at Luisenthal Colliery. Klaer, E.; Hassdentenfel, H. *Glueckauf;* **113**: No. 21, 1036-1039(3 Nov 1977). (In German).

The cable belt conveyor at Luisenthal Colliery is described. Details are given of cable life and of the economics of using this kind of conveyor. Cable belt conveyors are particularly suitable for bringing coal to the surface up great heights, but they are sometimes used to transport coal over long distances.

49455 Roadway support reinforcement with building materials. Henrich, F. *Glueckauf;* **113**: No. 21, 1039-1043(3 Nov 1977). (In German).

This paper discusses the composition and properties of natural and synthetic anhydrite, and cement-bound pack and reinforcement materials, and methods of placing them. Pneumatic stowing is particularly suitable for roadside packs. Wet and dry spraying, and backfills, are becoming more important at great depths.

49456 Vacuum contactors for underground use in coal mines. Jakszt, W.; Rimmrott, M. *Glueckauf;* **113**: No. 21, 1013-1046(Nov 1977). (In German).

As prored switchgears for operating voltages up to 7.2 kV, vacuum contactors have been used versatily in the industry. The outstanding virtues of this new technique consist in a compact construction nearly maintenance-free, no interactions of switch arc and environment, and a long mechanical and electrical life-time, unmatched by air contactors until now. Because of these special features vacuum contactors are particularly suited for use in underground mining. The large switching range and non-welded contacts of the contactor allow its protection by means of all measures common in the mining industry in view of starting currents of high-capacity motors.

49457 Shield supports at La Houve mine. Follins, D. *Trav. Maitrise, Mines;* 2-4(Nov 1977).

This paper discusses the use of shield supports by Houilleres du Bassin de Lorraine. Describes the supports used in detail and their use. The shields are moved forward after the passage of the shearer and then the armoured conveyor is moved. The supports are transported in two parts. The advantages and disadvantages of the supports are noted.

49458 Exemplary productivity from best workings in France. Rougeron, R. *Ind. Tech.;* No. 354, 78-81(20 Oct 1977). (In French).

A brief report on a visit to Houilleres du Bassin de Lorraine, more especially to a working at La Houve in the Theodore seam, where 7 men produced 5000 tonnes/day during 24 consecutive working days. The average take, on bottom working, is 6074 kg, which ranks it third in France. Gives general information concerning the Lorraine coal fields employing about 20,000 people for a production of 9,969,000 tonnes in the year 1976. Future prospects are examined.

49459 Modification of a jumbo bolter. Gondat, R.; Bultez, J. *Faire Equipe;* 12-13(Oct 1977). (In French).

The four operations involved between bringing up a jumbo bolter and the bolt hole drilling stage are described. The risk of accidents during these operations is noted. Describes the modification of the bolter to remedy this.

49460 Hydraulic rock breaker for underground crushers. Rousset, M. *Faire Equipe;* 14-15(Oct 1977). (In French).

This paper discusses the problem of unblocking crushers used underground using a remote controlled rock breaker. The installation and its method of use is described. The time saving and the increased safety aspects are noted.

49461 Significance of mining parameters in the exploitation of coal seams in view of fire protection against spontaneous fires. Lindenau, N.J.; Belarentsev, L.P.; Miller, Y.A. *Neue Bergbautech.;* **10**: No. 619, 65-68(Oct 1977).

In the period 1971 to 1975 in the Prokop'evko-Kiselevsko region an average of 30 endogenous fires occurred per annum (due to particular geological circumstances causing self-ignition). The preventive means of installing a partition wall entails low productivity. Investigations showed the necessity of obtaining mining parameters of endangered seams and that fire prevention is possible when security instructions are based on the mining parameters. One hundred-sixty working faces were surveyed, and data was periodically obtained on ventilation parameters. Facts and requirements were compared. An outline of productivity is given, stating the type of exploitation and geological conditions. Twenty-three endogenous fires during the survey period were due to nonobservance of instructions (mainly concerning speed and ventilation regulations, and special preventive measures). For the examination of the effects of mining parameters in the complex of fire preventive regulations, the working fields were divided into two groups. Analysis showed that the most effective measures for fire prevention are a maximal increase in the speed of advance and a minimal decrease of waste coal in endangered layers. This result was confirmed in practice. Due to the introduction of preventive measures, the number of endogenous fires decreased by 32% in 1976 in comparison to 1975 in the region under survey, although mining and special preventive measures were not fully observed. A further decrease of 50 to 60% in comparison with 1976 should be possible.

49462 Unloading of mine railways and bogies. Mishim, V.V.; Zhbrev, V.A.; Kurkula, O.N. *Ugol;* **10**: No. 619, 53-56(Oct 1977).

The future trend is to employ wagon and bogie unloading operations underground. This system permits an increase in productivity in underground transport, improvement in organization production and decrease in secondary equipment. Practical use proved the effectiveness of the following wagons (VDK) and (PC). Productivity is determined by the unloading time. A considerable time loss occurs during the unloading of rock pieces smaller than 0.01 m. General unloading time depends largely on the width of the unloading opening; therefore, in the case of 600 mm tracks, the unloading pit should be longer than for 900 mm tracks. For wagon type VDK-2.5 to 4.2 sec. The general unloading time changes insignificantly with an increase in the wagon capacity and proportional increase of the unloading aperture of the wagon. With an alteration of the loading pit length from 1.05 to ? m, the unloading time decreases by 1.4 sec. in the case of wagon type VD-3.3, for wagon type VDK-2.5 by 1.2 sec. It is necessary to calculate the length of the unloading pit in combination with the respective train speed in relation to rock size and moisture content for the respective wagon capacity, thereby determining unloading time.

49463 Steering shaft of the bucket wheel excavator's bracket of a brown coal excavator equipment in welding construction. Isenberg, W. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Gustavsburg (Germany, F.R.). Werk Gustavsburg). *Schweissen Schneiden;* **29**: No. 9, 350-354(Sep 1977). (In German).

Using the example of the bucket wheel excavator bracket of an excavator equipment for mining brown coal, points of view on correct welded and strengthened construction are given. The construction of plant for 240,000 cu. metres output per day, above ground statics, design and measurement (taking into account various classes of quality) and the manufacture of the inner bearing halves of St 52, pre-assembly at works and testing are treated. It is shown that with correct configuration and detailed planning, even complicated welded constructions can be successfully completed.

49464 Questions concerning artificial lighting in mines in the GDR. Junghaus, R.; Drees, W. *Neue Bergbautech.;* **7**: No. 9, 669-673(Sep 1977).

The use of artificial lighting underground is examined with reference to the present shortcomings and the ensuing consequences with the intention of outlining an ideal lighting system allowing for higher production, and improved working conditions. Good visual conditions imply better safety conditions, less fatique, increased tidiness and cleanliness, speedier clearing, improved orientation, less damage to cables and pipes, shorter repair time, and better working conditions. Miners in charge should be instructed so that they have at least a minimum knowledge of lighting systems. Importance should be placed on the correct choice of lamp. The use of fluorescent lights and the conventional light bulb can be justified when they are frequently switched on and off but the former should be recommended where work conditions call for continuous use. In this respect attempts should be made to introduce high-pressure sodium lamps. In addition, time factors and age of miners need to be taken into consideration. Routine medical examinations should always include eyesight examinations.

49465 Use of roof bolts in coal mines. Hake, K. *Neue Bergbautech.;* 7: No. 9, 664-668(Sep 1977).

The use of bolts for securing the roofs of galleries and junctions in underground mining requires extensive preparatory investigation into various aspects including the load-shift behavior as related to the attachment parameters, the type and structure of rock, the loading conditions and the time, the load-deformation process in the rock to be bolted, particularly with respect to the deformation potential around the pit, the type and direction of the load applied to the bolt, and the interactions between the mining operations and the rock including the interactions between the various types of mining in the case of combined methods. In addition, the load applied to the bolt as well as the deformation of the rock have to be measured, at least in the experimental stage. When continuous deformations are expected, measuring sites have to be organized systematically for the whole of the utilization period.

49466 Current injection-grouting methods in underground workings. Lange, W. *Neue Bergbautech.;* 7: No. 9, 641-647(Sep 1977).

The sealing of inflows in underground workings is a process which has a direct effect on the productivity of a coal mine. Injection is the main sealing method, as it calls for only minimal technical aids and does not lead to any considerable interruptions in the working of the mine. In the cases of the insulation of safety embankments and shaft cylinders only injection can be used, although the success ratio of injection-grouting is rarely 100% (normally 90%). The use and potential of injection, especially in areas with unfavorable geological conditions, should be realised and extended. Current means of injection are discussed with their corresponding properties. Although over 100 sealing products have been patented, only 4 types are recommended: mixtures of cement and sand; chemical products based on sulphite liquor and either nitrogen or calcium bichromate; organic resins; and bitumen emulsions. Different methods are recommended for different conditions. The use of cement alone is discouraged. Further research in the development of injection is recommended.

49467 Reason for the origin and the parameters of vibrational wave processes in upper strata due to sudden coal and gas bursts. Osipov, S.N. *Ugol Ukr.;* **9**: 37-40(Sep 1977).

In the interest of elaborating vibrational wave mechanisms by sudden bursts of coal and gas, all possible parameters of the upper stratum were analyzed subject to their formation conditions. A thin elliptically shaped lamina was measured and researched analogously based on building mechanical calculations. The basic original reason for the vibrational wave processes in the upper stratum is a rapid shifting of the zones with a high tension in the direction of the pit floor surface. In this manner the danger of one abrupt burst of coal and gas arises due to a significant maximum decline of the supporting pressure and its return to the original place subject to given qualifications. In conclusion, further knowledge about the mechanism of sudden coal and gas bursts could be achieved through the examination of the foundation conditions and the development of dynamic methane desorption.

49468 Preparatory work in roadway construction. Khutornoi, V.F.; Patrikeev, G.I.; Baturintsev, V.A. *Ugol Ukr.;* **9**: 13-14(Sep 1977).

In the Don Basin, preparatory mining was protected behind a wall at the edge of the deposit by rubble zones which were 8 m thick and reinforced concrete posts or an organ-shaped set of wooden struts of trapezoid shape strengthened by metal posts which yielded horizontally and vertically in a depth of 450 m with a layer of 1.3 to 1.5 m thickness and angle of incidence of 1 to 3 degrees. The roof consisted of limestone (up to 1 m), argillite (8 to 12 m) and sandstone (10 m), and the floor was composed of argillite, alevrite and sandstone. The length of the field was up to 2.5 km, the fall 180 m, the monthly progress 75 m. The conveyor footway had a cross section of 11.2 sq. m. and was reinforced with metal arches (one frame 1 m). For better protection, hydraulic power supports were used 15 to 20 m away from the working face, which were moved on every 50 to 70 m and had a resistance of 150 t/m. This process has proved to be very safe and economical; 60 roubles could be saved per meter.resistance of 150 t/m. This process has proved to be very safe and economical; 60 roubles could be saved per meter.

49469 New construction methods for coal excavation. Curpal, F.M. *Ugol Ukr.;* **9**: 1-5(Sep 1977).

New methods are described for the opening and preparation of new levels on sloping layers of coal, taking into account new systems and equipment for cleaning and preparation work, means of transport and ventilation. Five stages can be observed: (1) Between 1950 and 1955 with partial reconstruction and in small depths an annual output of 350,000 to 600,000 tons of coal was achieved. (2) Between 1960 and 1969 the depths were greater and 600,000 to 1,200,000 tons were achieved with full or partial reconstruction. Until 1970 the pits were located below the main transport level and arranged according to the scheme: slope-slope-gradient. However, the equipment available was insufficient, the room available was inadequate for working and the process was too time-consuming. (3) Between 1970 and 1975, 1.2 million tons were achieved using old pits of a medium depth. More concentrated work was possible with or without reconstruction. No new large gradients had to be built. Mining was simplified, the transport of the workers was accelerated and better ventilation was provided. (4) In the fourth stage (1976 to 1980) areas of 4.5 to 5 km (before 2 to 2.5) could be mined horizonatally, and depths of 1.6 to 2 km (1 to 1.2) could be achieved. New solutions provide pit systems with vertical and horizontal transport, direct ventilation, transport of coal on conveyor belts; all shafts can be linked; the process is cheaper and quicker, the shafts more stable. (5) In the fifth stage vertical shafts on two levels are planned to increase safety. Additional auxiliary shafts will be provided and existing shafts will be used for deepening instead of deepening from the surface or one of the levels.

49470 Cutting coal getting with different types of picks. Eichbaum, F.; Bendlmayr, H. *Glueckauf;* **113**: No. 16, 788-800(Aug 1977). (In German).

The results of comparative investigations between tangentially arranged round picks and radially arranged flat picks are stated.

49471 Compact borehole probe for gas flow measurements. Stegmanns, W.; Heller, D. *Glueckauf;* **113**: No. 16, 809-812(Aug 1977). (In German).

In cooperation with the Forschungstelle fuer Grubenwetterung of the Bergbau-Forschung GmbH a measurement part for methane concentrations of 0 to 100% was developed by DAG to the existing borehole probe for flow velocity measurements. In planning and construction consideration had be given such that certain dimensions were not exceeded and that the electrical values corresponded to the demands of intrinsical safety of firedamp protection. After the development of a functional, ready-to-use proto-type, which was tested and approved in the Berggewerkschaftliche Versuchsstrecke of the Westfaelische Berggewerkschaftskasse practical measurement underground took place. The Landesoberbergamt Nordrhein-Westfalen gave the Forschungsstelle fuer Grubenwetterung a special licence for the applications in methane drainage boreholes. During the course of further development, technical inprovements which led to a smaller compaet borehole probe, were carried out.

49472 Roof control by co-action of several measures. Meyer-Friedrich, A. *Glueckauf;* **113**: No. 15, 757-759(Aug 1977). (In German).

Measures are described which have to be applied when under unfavorable conditions secure top coal support is of the utmost importance in order to facilitate safe hanlage.

49473 Early detection of the hazards of gas outbursts on the basis of a determination of the K-value. Janas, H.; Winter, K. *Glueckauf-Forschungsh.;* **38**: No. 4, 131-138(Aug 1977). (In German).

Two important characteristics for judging the danger of gas outbursts can be determined using desorption meter measurements: The k/sub t/ value; this characterises the tendency for gas outbursts to occur for coal. It is largely dependent on gas content, the grain size, the ash component, the weight and the type of band (of bituminous coal), as well as the degree of coking up of the sample. The v_1 value; this gives the amount of methane desorption flow for 1 minute after releasing the sample from the absorption equilibrium. As for the Δp value, this is affected by the methane content, the grain size, the weight and the ash content of the sample. With a normal coal face, not tending to produce gas outbursts, the scatter of k/sub t/ values is relatively small. A larger scatter of k/sub t/ values raises the suspicion of possible approach to a gas outburst zone. There is a tendency for gas outbursts to occur, if more than 5% of the sample have k/sub t/ values$>$0.75. If the desorable gas content amounts to $>$9cu. metres/tonne (this can be judged using the v_1 value) then there is a danger of gas outbursts. Preventive measures against this danger must be immediately instituted. The result of preventive measures can be evaluated locally by determination of the v_1 value of coal samples from inspection bores. The remaining methane content at the sampling positions is determined from the v_1 values. To simplify measurements and for immediate evaluation of local results of investigations automatic desorption meters with electronic evaluation of results of investigations are being developed by the Test Department for Mining Ventilation of the Westphalian Mining Co, Bochum.

49474 Method and device for winning and transporting in stratified mining below ground. Schulte, A. (to Westfaelische Berggewerkschaftskasse, Bochum (Germany, F.R.)). German(FRG) Patent 1,801,010/B/. 8 Jun 1977. 4p. (In German).

The mining of minerals (preferably hard coal) which can be extracted by face mining is carried out by scraping planes, which are connected with a continuously operating face conveyor (e.g. double chain conveyor). The conveyor and plane drives are separate. As different quantities of coal are released with scraping mining and with downward clearing of the path of the plane, the optimum conveyor capacity cannot be fully utilised. To achieve optimum conditions, it is proposed that two planes should work with time displacement over the same face, and that the overlapping cutting length between the working areas of the two planes should be preworked by the lower plane in mining. Further claims contain the possibility of using an auxiliary plane in preliminary work of the overlapping length of face, and during descent a trench is made by cutting. The possibility of separate drives of the two planes and their working in two seams is mentioned.

49475 Tests on the influence of concussion blasting associated with drilling destressing boreholes in roadsides, on the reduction of gas and rock outburst hazards. Kozlowski, B.; Siarkiewicz, R. *Przegl. Gorn.;* **33**: No. 6, 1-5(Jun 1977). (In Polish).

A new method for concussion blasting associated with drilling destressing (outgassing) boreholes in roadsides is presented.

Explosive charges are fixed in four concussion boreholes 6m long and 42 mm in diameter to destress the solid coal ahead of the face. Where dangerous gas pressures persisted in spite of concussion blasting, additional destressing of roadsides was effected by drilling small diameter boreholes.

49476 Principles of simulation of the study of problems in mine ventilation at laboratory level. Nath, K. *J. Mines, Met. Fuels;* **25**: No. 6, 166-170(Jun 1977).

Work on a model corresponds to full-scale operation when geometric, kinematic and dynamic similarity exist. Reynolds number is an exact similarity parameter only for laminar flow: air flow in mines is turbulent. This paper explains the principles of similarity and the use of models to simulate mine roadways.

49477 Optimising problem in mine planning. Chakravarty, J.L.; Sinha, D.K. *J. Mines, Met. Fuels;* **25**: No. 6, 161-165(Jun 1977).

Procedure to be followed when planning new mines is outlined. The problem is to allocate production optimally between various coalfields.

49478 EC research program 'Operational safety in mining'. *Technol.-Nachr. Manage.-Inf.;* No. 207, 12-15(Jan 1977). (In German).

Taking into account the necessity of promoting research in the field of pit safety and its adaptation to methods of production and coal winning, the positive opinions and positive approval of experts, governmental and scientific advisory committees as well as the views of research institutes and technical bodies which were approached, and taking into account section 55 of the European Coal and Steel Company treaty, the Commission allows 7,500,000 u.a. for carrying out a research program called 'Operational safety in mining' which is to have its beginning in 1976 and which will run for 5 years.

49479 Electric motors. *Publ. Tech. Charbon. Fr., Inf. Tech.;* No. 7, 393(1977). (In French).

The different types of electric motors available for use in mines are compared.

49480 Vision and lighting underground. Portal, G. *Publ. Tech. Charbon. Fr., Inf. Tech.;* No. 7, 345-356(1977). (In French).

This paper discusses the progress made in lighting for underground mines, particularly at the face to facilitate work and improve safety. Ambient lighting has become necessary. The physiology of the eye is discussed with the necessary conditions for good lighting. It also expresses the need for an approved lightmeter to measure lighting and luminous intensity underground. There is scope for improvement in lighting systems at the face.

49481 Infusion of water into a coal mass, carried out at the mines of Houilleres du Bassin du Nord et du Pas-de-Calais. *Publ. Tech. Charbon. Fr., Inf. Tech.;* No. 4, 143-196(1977). (In French).

This paper reports on research work concerning water infusion in order to reduce dust danger at working face. It also describes development of the process since 1950; improvements to various low flow methods; and factors governing the choice of a process. Infusion can be carried out from working face, or from levels. The paper also describes hole drilling (equipment and methods used); fitting out holes (equipment, cementing); inspection; and non-stop infusion.

49482 Mining the Masse face in the Vieux-Conde mine Houilleres du Bassin du Nord et du Pas-de-Calais. *Publ. Tech. Charbon. Fr., Inf. Tech.;* No. 3, 139-140(1977). (In French).

This paper describes the deposit at the Ledous-Vieux-Conde workings. The Masse seam is being worked such that the layout allows the introduction of modern mining machines and support where the dip varies from 18 to 44 degrees; the face length is 110 to 158 metres. It describes the coal plough, the armoured flexible conveyors, and the powered supports used and discusses the introduction and installation of this equipment at the face. A table shows results and productivity figures.

49483 Efficiency of Schaefer S113 bolting on G1-120 Sections as determined by tests with models. Buschmann, N. *Publ. Tech. Charbon. Fr., Inf. Tech.;* No. 3, 126(1977). (In French).

Tests on models in pure aluminium, scale 1:10, carried out by Bergbau-Forschung on the effect of SCHAEFER'S S113 Bolting in respect of load bearing capacity and resistance to deformation of rigid 4-piece gallery arches are described. Details of tests and results obtained are given. With this bolting the frame remains in its original plane even with an extreme 20% convergence, whereas non-bolted frames suffer from torsional effects and lateral deviation.

49484 Tenth financial year, 1976. Houthalen, Belgium; NV Kempense Steenkolenmijnen (1977). 78p. (In French and Dutch).

The annual report to shareholders discusses the situation of the coal industry in Belgium and in the EEC. The company's activities are set out: production, productivity, new work carried out, personnel, and safety. The financial report for the year is presented.

49485 Dust control at the ends of longwall faces. Final report. Burton-on-Trent, Eng.; Mining Research and Development Establishment (1977). 32p.

Report describes the work carried out to provide more effective dust control for a variety of face-end operations, namely: stablehole extraction by the in-seam miner; roadway ripping (behind and on the face line) using the Joy and Dosco cutter pick machines and the Macol impact ripping machine; and advanced heading drivage using boom-type heading machines and the Dosco dintheader.

49486 Device for ensuring safety of the coal face in coal mines with suspended cutting. Floeter, M. (to Gewerkschaft Eisenhuette Westfalia, Luenen (Germany, F.R.)). German(FRG) Patent 1,800,846/C/. 9 Dec 1976. 4p. (In German).

With suspended working of a coal seam, the working space must be protected against the ingress of the roof and of the coal. This is achieved by projecting covers against the roof and with holding members connected by joints against the coal face. In order to fulfil this task properly, the use of a flat spring is recommended, which has a sliding support in the projecting cover. A hydraulic cylinder exerts pressure simultaneously on the holding member connected by joints, against the coal face, and on the flat spring, to press it against the roof. This arrangement protects the particularly dangerous joint between the coal face and the roof. A further claim provides for the bending of the steel spring at the support plate joint against the roof.

49487 Method and device for support and safety of the opening against uncontrolled falling coal set free during the drive. Groetschel, K.M. German(FRG) Patent 2,501,302/C/. 2 Dec 1976. 7p. (In German).

A telescopic traversing device scans the two chambers of the openings traversely to the drive direction. By means of a cross-like bracing of the traversing device between both lateral chambers on the one hand, and between hanging wall and floor on the other, a point of reference is created, through which the moving support unit following behind can be drawn. Before advancing the reference point step by step, an instationary support unit is braced between hanging wall and floor. It serves as an abutment for advancing the point of reference. In front of the reference point coal and debris material falling down during the drive are collected and carried off to the side by means of a tiltable protective shield. The telescope-like shift of the traversing device, the swivelling of the protective shield, the advancement of the traversing device and the follow-up of the moving support unit are carried out by piston cylinder devices. Apart from horizontal seams, the device is also suitable for angled ones.

49488 Recent coalmining developments in Britain. Dunn, R.B. (National Coal Board, London). *Met. Miner. Rev.;* **15**: No. 3, 27-30(Feb 1976).

The emergent specialism during the last two decades of coalmining in Britain has been the longwall face mechanization program, and the mechanization engineer now has a prominent place in the industry's technical and management structure. More recently, some of the techniques employed have been modified for use in the drivage of underground roadways to meet the needs of faster extraction, and in particular to allow the industry to develop its potential for retreat methods of working where mining conditions are suitable. In common with other industries, the attention of the National Coal Board (NCB) has been turned to the need for remote control of machinery as a means by which automation can be adopted at a later stage. In all these developments it is becoming increasingly clear that advanced-technology mining depends on designing systems rather than machines, and as a consequence the design problems center on the interface relationship between one mechanism and another when built into a common system.

49489 Comparison of coal winning with a shearer-loader with a coal plough with regard to face height. Hucz, N. *Publ. Hung. Min. Res. Inst.;* No. 19, 77-84(1976). (In German).

This paper presents a method of determining the maximum permissible face height for a given combination of winning machine and face conveyor. For shearer loaders a suitable conveyor can always be found, but for ploughs the maximum face height is usually 2.1 m. However, this can be increased to 2.9 m if the cutting width is reduced, or, at cutting speeds of less than 0.4m/s, in seams which are easy to plough. High speed ploughing can be used up to a face height of 1.5 m, and if the depth of cut is reduced, the face height can be increased at 2.3 m. A further increase in face height would require a much greater conveyor size.

49490 Factors affecting the load carrying capacity of yielding ring supports. Bodonyi, J.; Benecz, I. *Publ. Hung. Min. Res. Inst.;* No. 19, 53-58(1976).

Describes experience with the use and development of yielding rings as roadway supports, and discusses factors affecting the loadbearing capacity of steel segments which are clamped together, and the effect of eccentric pressures produced by overlapped binding elements. An analysis is presented of the stresses induced by loading when the rings start to yield.

49491 Factors affecting variations in time of the remote effects of depression in the surroundings of Thorez opencast mine. Szilagyi, G. *Publ. Hung. Min. Res. Inst.;* No. 19, 43-51(1976). (In French).

Dewatering operations have been carried out in Thorez opencast coal mine since 1960 in order to increase the stability of waterbearing strata and to create safe working conditions. Since that time some 0.1 billion cu.m of water have been drained from underground reservoirs, resulting in the formation of a zone of depression 10 to 15 km in radius. Hydrogeological and technical factors affecting the variations in time of the remote effects of depression are analysed. It is found that the decisive influence is the variation in the volume of accumulated water, and to a lesser extent, the effect of the positioning of the drainage system.

49492 Technical and technological conditions of producing and utilizing some mineral substances mined in Hungary. Martos, F. *Publ. Hung. Min. Res. Inst.;* No. 19, 9-20(1976). (In Russian).

Equipments which can be used to extract thick coal seams, or to mine bauxite deposits, are considered. Thick seam mining can be imporved by reducing the number of slices and increasing the speed of face advance by using shield supports 3.5 to 4.5 m high.

49493 Innovation in coal mining machinery: the Anderton shearer loader: the role of the NCB and the supply industry in its development. Townsend, J.F. London; National Coal Board (1976). 95p.

Paper describes the circumstances in the British coal industry leading to mechanisation and the need for shearer loaders. The development of the Anderton shear loader (ASL) between 1951 and 1975 is studied with particular attention paid to the processes of "increment innovation." The role of the NCB and the British mining equipment industry is examined.

49494 Dynamic effect of bumps on supports. Olaszowski, W. *Arch. Gorn.;* **21**: No. 1, 37-64(1976). (In Polish).

The causes of bumps are outlined, and formulae are given for the frequency of vibrations of the roof, and for the relationships between the loadbearing capacity of the support and the amplitude and frequency of the rock movements. The instrument used to measure the vibrations is described.

49495 Stress studies on winning machine ripping picks. Bocsanczy, T.; Kereszturi, F. *Freiberg. Forschungsh., A;* **539**: 195-209(1975).

On the basis of optical measurements of stresses in picks during winning, the optimum pick shape can be selected. The shape and position of the hard surface, and load on the pick shaft, can also be optimized. The results of such measurements are reported.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 49350, 49386, 49524

49496 (EPA—600/7-78-038) **Washability and analytical evaluation of potential pollution from trace elements in coal.** Cavallaro, J.A.; Deurbrouck, A.W.; Schultz, H.; Gibbon, G.A.; Hattman, E.A. (Department of Energy, Pittsburgh, Pa. (USA). Pittsburgh Energy Research Center; Environmental Protection Agency, Research Triangle Park, N.C. (USA). Industrial Environmental Research Lab.). Mar 1978. 41p. Dep. NTIS, PC A03/MF A01.

This report presents the results of a washability study showing the trace element contents of various specific gravity fractions for 10 coal samples collected from various coal-producing regions of the United States. Reliable analytical methods were developed to determine cadmium, chromium, copper, fluorine, mercury, manganese, nickel, and lead in the whole coals and the various specific gravity fractions of the coals. The material balances for the 8 trace elements for the 10 coals ranged from 85 to 115 percent with an average of 99 percent and a 95-percent confidence interval of +-3 percent. The magnitude of the concentrations of the various trace elements varied quite a bit from coalbed to coalbed within a region and also from region to region. The data from the analytical determinations on the washed coals are plotted as washability curves so that the quantity and quality of the clean coal products can be obtained at the desired specific gravity of separation. Generally, the data showed that most of the trace elements of interest concentrated in the heavier specific gravity fractions of the coal, indicating that they are associated with mineral matter; removal of this material should result in significant trace element reductions, ranging up to 88 percent. A list of references of other studies of trace elements in coal is presented.

49497 Progress concerning control and arrangement of shaft winding installations. Jehmlich, G. *Neue Bergbautech.;* **7**: No. 9, 648-651(Sep 1977).

A survey is given on the use of objective control procedures and measuring methods in shaft winding in the mining industry in the GDR, the purpose being to improve safety and bring about higher productivity. Practical investigations with the aid of models showed that magneto-inductive control is indispensible, though a combination with visual control (at certain places) is necessary. High safety standards with respect to the main driving machinery is impossible without regular use of horizontal acceleration measurements. The employment of the new complex system of appliances leads primarily to a higher safety level, a comprehensive assessment of operating conditions, avoidance of critical operating conditions by preventive measures, significant time saving for multi-cable hauling installations and higher productivity. The Institut fuer Bergbausicherheit (Mining Safety) developed a monitoring safety device for large scale hauling installations using Dederon cables that in practice proved braking to be safe.

49498 Coal preparation on the Hanover Fair 1977. Koehling, R. *Glueckauf;* **113**: No. 15, 739-742(Aug 1977). (In German).

Preparation machines mainly for coal, which were exhibited at the 1977 Hanover fair, are briefly described.

49499 Use of wetting agents to reduce the consumption of water used in dust suppression in coal washeries. Guruswarny, G. *J. Mines, Met. Fuels;* **25**: No. 7, 191-193(Jul 1977).

Wetting agents added to the water which is sprayed on coal to suppress dust improve wetting of the fines. The criteria which must be considered before a specific agent can be recommended are listed and laboratory tests are described which aid in the selection of the agent.

49500 Safety measures when dedusting presses in a coke briquetting plant. Feiler, W. *Neue Bergbautech.;* **7**: No. 6, 442-445(Jun 1977). (In German).

The causes of dust explosions and ignitions in the presses and the reasons why dust deposits form on machinery, are discussed. The safety measures recommended are the use of explosion relief devices, equipment which can withstand explosion pressures, monitoring equipment to detect sparks or pressure increase, and flame traps.

49501 Highest possible slurry concentration for flotation. Radek, O.; Sevesta, J. *Uhli;* **25**: No. 5, 193-196(May 1977).

The trend is to simplify the technology, thereby reducing investment costs for the preparation of coal dust and slurry during circulation and flotation. New flotation cells are able to bind far more coal waste than before so that some production phases concerning concentration and coal extraction from circulating water can be left out, although some additional equipment has to be installed. The new process also makes it easier to eliminate unwanted soil from coal particles. Some sketches of the proposed changes in technology are added. Raw coal 0 to 30 mm passes through bent riddles in order to sieve it. The small coal particles 0 to 0.5 mm are mixed with water and prepared for flotation, filtration and concentration. After the coal sedimentation process is completed, the fluid is pumped back for new circulation. The concentrated slurry containing 1.3 kg Flotakol in each ton proceeds to the briquette press. Calculations of the whole process showed a higher profit rate of between 3.66 and 5.50 Kronen for each ton of flotated slurry.

49502 Prevention of bridging in coal bunkers. Shatokha, I.Z.; Sychev, P.L.; Schastlivyi, A.I.; Simakova, N.M.; Ivanitskii, V.G.; Vasilenko, B.Ya.; Shchegolev, S.V.; Solov'ev, G.D. *Coke Chem., USSR (Engl. Transl.);* No. 11, 4-6(1976).

Translated from Koks Khim.; No. 11, 3-5(1976).

Research is reported on ways of preventing coal hanging in covered stockyard bunkers. If the first coal dumped in clean bunkers is oiled, hanging is completely eliminated.

49503 Coal crushing in impact crushers. Malonescu, A.; Falk, E.; Celinescu, I. (Metallurgical Research Inst., Bucharest). *Coke Chem., USSR (Engl. Transl.);* No. 11, 7-10(1976).

Translated from Koks Khim.; No. 11, 5-8(1976).

Research and commercial data are presented on the impact crushing of various coals. Impact crushers give improved preparation for carbonization at reduced power consumptions. They have a high throughput capacity and need little attention.

49504 Influence of basic process variables on centrifugal hydraulic coal separation. Semenov, I.A.; Korsak, L.L.; Drobysheva, Yu.F.; Labakhua, M.S. *Coke Chem., USSR (Engl. Transl.);* No. 7, 10-13(1976).

Translated from Koks Khim.; No. 7, 8-11(1976).

Laboratory and plant trials in various Soviet coal washeries have shown that coal slurries and fines can be cleaned by centrifugal hydraulic separation. As the ash of the slurry increases the process becomes more effective, i.e., the sulfur content and ash of the concentrate increase much less rapidly than those of the tailings. The basic static properties of the centrifugal hydraulic separation process for removing ash and sulfur from coal fines were quantitatively evaluated by the coincident or closely similar values of the major statistical measures. The most important process variables are the solids content of the incoming pulp, the ash of the original slurry, and the rotor speed. The pulp flow rate and liquid bath depth are minor variables. The proposed method of determining the sulfur contents of the products provides a practical means of controlling the cleaning process to maintain a specified product quality.

COMBUSTION

REFER ALSO TO CITATION(S) 49362, 49403, 49410, 49761, 49926, 50516, 50874

49505 (APAE—2687-11) **Case study applications of venture analysis: fluid bed. Progress report, March 25, 1978—April 21, 1978.** Edwards, J.B. (Energy Resources Co., Inc., Cambridge, Mass. (USA)). Apr 1978. Contract EX-77-C-01-2687. 24p. Dep. NTIS, PC A02/MF A01.

An evaluation of fluidized-bed combustors, including government energy policy, advantages and disadvantages, costs, etc. has been incorporated into a mathematical model to predict market penetration. Methods of incorporating a possible unreliability of the initial combustors into the model are described. The draft outline of a final report is included. (LTN)

49506 (FE—1770-35, pp 12-41) **Appendix: a theoretical study of burning carbon particles.** Libby, P.A. Nov 1977.

In Computer modeling of coal gasification reactors. Quarterly technical progress report, July 1, 1977—September 30, 1977.

Our treatment is organized as follows: we first consider a quasi-steady flow about a spherical particle with a specified surface temperature and under various conditions of composition and temperature in the surrounding ambient. In doing so we attempt to clarify the various chemical phenomena involved in the burning of carbon under conditions of interest in entrained flows. The second part of our study relates to the unsteady thermal response and mass loss of a particle which is initially cold and which is injected into a hot, oxidizing ambient. We consider the two cases of uniform temperature within the particle and of variable temperature as described by an approximate solution to the spherical Stefan problem. Throughout our considerations we invoke assumptions which, while physically satisfactory, permit the analysis to be carried forth with a minimum of numerical treatment. Suggestions for more accurate analysis are given as appropriate.

49507 Investigation of the flow conditions and the course of combustion in the combustion chamber of a TPP-312A type steam generator. Snicer, I.N.; Juriev, L.V.; Soloviov, L.K.; Litovkin, V.V. (Tsentral'nyi Nauchno-Issledovatel'skij Kotloturbinnyj Inst., Tagonrog (USSR). Kesselwerk; Tsentral'nyi Nauchno-Issledovatel'skij Kotloturbinnyj Inst., Uglegorsk (USSR). Kraftwerk). *Arch. Energiewirtsch.;* **32**: No. 3, 212-224(Mar 1978). (In German).

The aerodynamic flame behaviour, the character of gas formation, and the intensity of combustion were studied in a TPP-312A steam generator with a power of 950 t/h of 25 MPa, 565/570°C steam for the combustion of riddled Donez coal with liquid slag removal.

49508 Evolving a mathematical model of the heating of polydispersed coal in a flow of gas. Pustovoitenko, A.I. *Khim. Tverd. Topl.;* No. 2, 141-145(Mar 1977). (In Russian).

When constructing a model it is essential to take into account the transient nature of the heating of the particle and also the fact that particles can slip relative to the gas.

49509 Experimental determination of alkali impurity release from various dolomites. Yannopoulos, L.N.; Toth, J.L.; Pedler, A. *Combust. Flame;* **30**: No. 1, 61-69(1977).

Dolomite will be used to desulfurize coal gas in a proposed fluidized bed coal gasification/combined cycle power generation plant. Knowledge of the release of volatile alkali compounds from dolomites is required, since alkali metals are recognized corrodants of turbine materials. A flame emission photometric technique was developed to measure the emission of sodium and potassium compounds from five different dolomites as a function of time between 700 to 900°C in a simulated coal gas stream. The release of alkali is influenced mainly by the temperature, the alkali impurity content of the dolomite, chemical nature of the alkali vapor source(s), and the calcination of the dolomite.

49510 Additives for coal. Dixit, S.N.; Cuisia, D.G. pp 174-180 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

With proper selection and control of fuel additives, the beneficial effects of fireside treatment in operating power plant installations can be realized. Using an advanced stack gas sampler and an acid dewpoint meter, several functions of coal additives were demonstrated during actual field applications. Coal additives are capable of reducing acid dewpoint temperature of the flue gas, hence, minimizing boiler cold-end corrosion and substantially reducing smoke density and particulate loadings of the stack. Moreover, it was shown that additives can modify fireside deposits to a more desirable chemical composition.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 49402, 50491, 50516

49511 Use of plastics in the Soviet coal mining industry. Rozensal, M. *Przegl. Gorn.;* **33**: No. 4, 164-167(Apr 1977). (In Polish).

The present status of application of plastics in the Soviet coal mining industry is discussed. Plastics used on a large scale and research in this field are described.

49512 Superannuation investments department. Jenkins, H.R. (Natl Coal Board). *Colliery Guardian;* **226**: No. 1, 19, 22(Jan 1978).

Immediately following nationalization of the U.K. coal industry in 1947, the National Coal Board (NCB) established an earnings related superannuation scheme for at that time some 67,000 Board staff and officials. A Committee of Management was formed of five Board and five Union representatives and in the first few years more than 200 prenationalization Pension Schemes, their members and their investments, were assimilated into the newly established Staff Scheme. In this article, Director General of the NCB's Superannuation Department describes the functions and working of his department.

49513 Policies of coalmining firms in the nineteenth and twentieth centuries. Griffin, A.R. *Colliery Guardian;* **226**: No. 1, 51-55(Jan 1978).

The author deals with the policies of coal mining firms in the 19th and 20th centuries. Various factors that influenced changes in the industrial relations of the U.K. coalmining companies are discussed. These include social and economic factors, as well as advances in coalmining technology. 26 refs.

49514 Duties and results of the research field 'coal technologies'. Holighaus, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). *VGB Kraftwerkstech.;* **57**: No. 12, 832-839(Dec 1977). (In German).

The survey deals with research projects of the energy research program of the Federal Republic of Germany in the field of coal conversion technologies, as far as they are significant for the further development of power plant technologies. The concept pursued in this connection concerning power plants with pressurized, fluidized-bed firing, with a combined cycle with pressure gasification of coal and with a combined-cycle of VEW coal conversion, is outlined. Information is given on the further development of the Lurgi pressure gasifier, of the Texaco gasifier, of the Saarberg-Otto generator, of the Winkler high-temperature gasifier, and of the hydrogenation of coal.

49515 Future of coal in the energy economy. Delannoy, G. *Rev. Gen. Therm.;* **16**: No. 188/189, 627-632(Aug 1977).

Paper discusses the roles of coal and oil and notes that coal is set to become the dominant fuel. Cites uses where coal and oil can replace one another (e.g., heating, steam production) and specific uses for coal. Discusses the needs of the French iron and steel industries and the development (by Cerchar and Irsid) of new processes. Notes successful research on coal-derived products, e.g., methane from coal gasification, in-situ gasification, and the production of petrol by hydrogenation. The costs of these processes should eventually become economically viable. Mentions uses of coal by-products and waste, e.g., carbon fibres, active carbon, and sintered and forged carbons.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 49453, 49461, 49464, 49467, 49475, 49478, 51270

49516 Development of gravimetric dust measurement and investigation of individual dust exposure in hard coal mining. Bauer, H.D. *Kompass;* **87**: No. 6, 163-172(Jun 1977). (In German).

The results of tests with the SIMPEDS 70 personal dust sampler are reported. In addition to tests on this instrument, the dust concentration at various work places was measured, and the frequency of measurements necessary to determine the daily dust exposure was determined. It was concluded that the instrument was suitable as a personal sampler, whereas an instrument with a greater volume flow is necessary for stationary monitoring.

49517 Employee involvement in health and safety measures in coal mining. Gormley, J. *Colliery Guardian;* **226**: No. 2, 101-105(Feb 1978).

Paper discusses Trade Union involvement in safety and health matters in the UK since the middle of the nineteenth century.

49518 New mine rescue system is ready in South Africa. Holz, P. *Coal Min. Process.;* **14**: No. 11, 68-70(Nov 1977).

In an underground rescue attempt, a probe hole is drilled, through which water, food, air and medical supplies can be lowered. A larger hole is drilled nearby, and men can be hauled to the surface through this in a Dahlbusch bomb.

49519 Cabs on jumbos and continuous miners: reduction of noise and dust. Rotatinti, J.; Daysson, S. *Faire Equipe;* 4-9(Oct 1977). (In French).

This paper discusses noise in underground workings and methods of control. The use of cabs on jumbos at the Saizerais mine and on Jeffrey continuous miners is described. Considerable improvements were obtained. Similar results were obtained at the Rochonvillers mine.

49520 Improvement of safety conditions for workers in coal mining. Boemer, A. *Glueckauf;* **113**: No. 15, 767-769(Aug 1977). (In German).

In a closing lecture on the occasion of a training course for the education of technical personnel for industrial safety in coal mining, development and plans for the prevention of industrial accidents and occupational diseases are reported on and the general idea of the educational program is presented.

49521 Investigations on the behaviour of isofoam during burning. Reisner, W. *Glueckauf-Forschungsh.;* **38**: No. 4, 139-143(Aug 1977). (In German).

The use of isofoams in underground coal mining requires among other things the investigation of its behavior during burning. Having carried aut 5 official and internationally tested procedures, this synthetic foam was assessed accordingly. In 4 cases the best criteria were attained whereas on the basis of the fifth testing standard not the best assessment, but nevertheless the most self-extinguishing property was confirmed without reservation.

REGULATIONS

REFER ALSO TO CITATION(S) 50493

49522 (NP—23222) **Benefit cost analyses of laws and regulations affecting coal: case studies on reclamation, air pollution, and health and safety laws and regulations.** (Energy and Environmental Analysis, Inc., Arlington, Va. (USA)). Jul 1977. 360p. GPO.

Recent years have seen the institution of numerous Federal, State and local laws, regulations and standards designed to affect the supply and consumption of coal. Specific examples of the types of laws and regulations which have changed rapidly in recent years are those relating to air and water pollution control, mine reclamation, diligence, and mine health and safety. In the face of these rapid changes, it is becoming increasingly difficult to know whether the numerous new laws and regulations, by themselves and in concept with each other, result in a net social benefit or cost to society. In an attempt to study this question, the Office of Minerals Policy and Research Analysis has contracted for a two-part benefit-cost study of these laws and regulations. While this study is in no way presented as the final answer to these complex questions, it is hoped that the analysis represents a positive contribution to the body of knowledge required to develop sound public policy. It is further hoped that this study will spur further research into these important and complex issues. Regulations examined in detail are: Reclamation regulations, air pollution regulations and health and safety regulations.

49523 Where we agree: report of the National Coal Policy Project. Volume 2. Murray, F.X. (ed.). Boulder, CO; Westview Press, Inc. (1978). 490p.

This volume contains the Mining Task Force Report of the National Coal Policy Project. The Mining Report is divided into four sections. Section I sets the context for the report with the introduction, executive summary and background information. Section II synthesizes the results of regional mining impact analyses and provides national and regional policy recommendations on seven major issues. Section III provides extensive environmental/economic regional analyses of mining impacts in the major coal provinces of the United States. Conclusions and policy recommendations are presented based upon the analyses. Much of the information in this section is synthesized in Section II. Section IV contains supplemental materials.

49524 Where we agree: report of the National Coal Policy Project. Volume 1. Murray, F.X. (ed.). Boulder, CO; Westview Press, Inc. (1978). 347p.

The report of the National Coal Policy Project is entitled Where We Agree to focus attention on the broad areas of agreement reached by the project participants. This one-year project brought together leading individuals from environmental and industry groups to seek consensus on important national policy issues related to the use of coal in an environmentally and economically acceptable manner. Task forces were responsible for exploring specific areas of interest: transportation, air pollution, fuel utilization and conservation, energy pricing, and emission charges. Volume 1 contains the full task force reports on transportation, air pollution, fuel utilization and conservation, energy pricing, and emission charges. Because of its length and technical nature, the mining task force report makes up all of Volume 2. The mining report defines—on a regional and national basis—the technical, social, legal, and administrative requirements for ensuring that coal is mined in an environmentally sound manner. A summary of the project, available from the Center for Strategic and International Studies (CSIS), provides a synthesis of the project's findings and individual summaries of each task force report. Consensus was reached on more than 150 recommendations related to such issues as locations and patterns of coal development, coal reserve quality and quantity, reclamation, the effects of development on water resources, and the socioeconomic impacts of coal development.

49525 Coal technology: future developments in conversion, utilisation, and unconventional mining in the United Kingdom. London; Department of Energy (1977). 34p.

Given the combination of expertise, relevance to the UK economy and commercial prospects, the Working Party makes the following recommendations concerning the proposals put forward by NCB and BGC: The Government should be prepared to make immediate major/substantial contributions to the cost of implementation of the following project proposals: (i) Liquid solvent extraction (total cost 16.2 million pounds), (ii) Supercritical gas-solvent extraction (total cost 14.8 million pounds), (iii) The entrained-flow/fixed-bed composite gasifier (total cost 12 million pounds); NCB and CEGB should be encouraged to carry out a feasibility study on the prospects for low Btu gasification applied to high efficiency electrical power generation. When preliminary work has progressed further to enable a judgment to be made of its potential, the Government should give sympathetic consideration to a larger scale project on pyrolysis. NCB in collaboration with Babcock and Wilcox should be encouraged to prepare a joint proposal to Government for the industrial scale demonstration of pressurized fluidized bed combustion for use in power generation; NCB should be encouraged in their studies of novel forms of in-situ extraction of energy in coal. When considering the level of Government financial support, each project should be judged on its individual merit. At the end of the design phase, each project should be reassessed by all the contributing parties, before a final commitment is made to the construction and operation phases. The Working Party should remain in being to review from time to time the whole field of coal technology against a background of depleting reserves of oil and natural gas.

PETROLEUM

REFER ALSO TO CITATION(S) 50497

49526 Canadian oil and natural gas developments. Calgary, Alberta; Petroleum and Natural Gas Dept. (1977). vp.

The map is of petroleum highlights and activities (fields, plants, refineries, etc.) in Canada, Arctic Islands, and MacKenzie Delta. The Alaska Highway pipeline is also covered. Charts of principal oil and gas fields in British Columbia, Saskatchewan,

Manitoba, and Alberta and of established natural gas reserves in Alberta are also included. (DLC)

RESERVES

REFER ALSO TO CITATION(S) 49400, 50476, 50498

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 49600, 50476, 50498, 51319

49527 (CONF-7706128—(Absts.)) **AAPG—SEPM program and abstracts, June 12—16, 1977.** (American Association of Petroleum Geologists, Inc., Midland, Tex.; Society of Economic Paleontologists and Mineralogists, Tulsa, Okla. (USA)). 1977. 116p. Dr. R.F Meyer, U.S. Geological Survey, Reston, VA.

From AAPG-SEPM program and abstracts; Washington, DC, USA (12 Jun 1977).

Abstracts of the technical papers presented at the June 1977 meeting of the American Association of Petroleum Geologists and the Society of Economic Paleontologists and Mineralogists in Washington, D.C., are given. Other information of use to those attending the meeting is included. (RWR)

49528 Genetic link of hydrocarbons in stripped part of oils with organic matter of cambrian deposits of the Baltic syneclise. Maksimov, S.P. *Int. Geol. Rev.;* **19**: No. 12, 1391-1395(Dec 1977).

Translated from Geologiya Nefti. i Gaza.: No. 2, 42-47(1977).

A genetic link between oils and source rocks of lower Paleozoic deposits of the Baltic syneclise is revealed from the identity of change in individual composition of hydrocarbons (HC) and their ratios along the section. It is marked most clearly from the pristane/phytane ratio and from the identical trend of n-alkane and isoprenoid distribution curves for oils and dispersed organic matter (OM). The patterns observed are complemented by the coincidence of maximums of carbon atoms in the higher molecular part (C_{25} - C_{35}) of n-alkanes and by the odd/even (O/E) molecular ratio. The sterane/triterpane and mononaphthenonaphthalene/phenanthrene ratios are found to be close.

49529 Estimate of prospects for petroleum occurrences in sedimentary rocks based on the metamorphic grade of the formation waters. Novosiletskiy, R.M.; Savka, E.P.; Sharun, D.V. *Int. Geol. Rev.;* **19**: No. 12, 1396-1398(Dec 1977).

Translated from Geologiya Nefti i Gaza: No. 3, 30-33(1977).

We consider quantitative relationships between the distribution of oil and gas deposits and the grade of metamorphism of the formation waters within petroliferous basins. The data, based on metamorphic grade, enable us to recognize three zones of different frequency of occurrence of oil and gas accumulations.

49530 Georadiological surveying for oil and gas and subsurface structure contour mapping. Murphy, J.A. US Patent 4,059,760. 22 Nov 1977. Filed date 6 Jul 1976. 8p.

A prospecting system is described for hydrocarbons using emanoradiation measurements of the neutron, beta, gamma rays, and radon gas emitted at the earth surface and atmosphere from the earth basement complex and, the overlying sedimentary deposits of carbonaceous rocks, shales and sandstone that are impregnated with uranium, thorium and potassium derived from the eroded earth basement complex materials. A number of check points are measured and the radiation levels are plotted to form a georadiograph. A comparison between the background level and the check point levels is used in determining the contour data basically of the earth's stratosphere, altered in its variation by hydrocarbons, radiation active substances, and/or mineral deposits. 2 claims, 10 figures.

49531 Nuclear well logging for petroleum, ch. 6. Hilchie, D.W. (Colorado School of Mines, Golden (USA)). pp 201-213 of Nuclear methods in mineral exploration and production. Morse, J.G. (ed.) (Colorado School of Mines, Golden (USA)). Amsterdam, Netherlands; Elsevier (1977).

Neutron and gamma logging techniques are discussed in relation to the exploration for petroleum. Natural gamma-ray logging, induced gamma-ray logging, steady-state neutron logging, pulsed neutron logging and carbon-oxygen logging are discussed.

49532 Volatile hydrocarbons (C_2-C_7) as indicators for natural oil and natural gas genesis in source rock. Leythaeuser, D.; Schaefer, R.G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe fuer Erdoel und Organische Geochemie). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **71/78**: 325-330(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Canned cuttings samples from several wells have been analysed for content and detailed composition of low molecular weight hydrocarbons (C_2-C_7) by a new procedure which includes capillary GC analysis. Interpretation of several light hydrocarbon parameters based on the geologic framework of the samples examined results in information concerning source rock quality (oil versus gas) and the diagenetic level to which hydrocarbon generation processes have advanced.

49533 Geophysical trend in natural oil and natural gas exploration. Duerschner, H.; Schoop, R.W. (Gewerkschaften Brigitta und Elwerath, Betriebsfuehrungsgesellschaft m.b.H., Hannover (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **71/78**: 437-460(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

There is no doubt that exploration for oil and gas is of vital importance for our whole society. Since exploration in Germany dates back for many years it is clear that the majority of easy discoveries - at least onshore has been made. To find the remaining reserves is much more difficult and forces us to develop methods far more precise than those used up to now. The geophysicist is faced with the task to improve the resolution of the seismic method and to extract a maximum of geologic and stratigraphic information from the relatively coarse seismic record. Through full utilisation of the computer potential of seismic exploration great progress has been made in meeting this challenge. The use of purely mathematical filter processes, and of correlation- and frequency analyses has greatly improved the resolution of the seismic data. Seismic modelling in 2 and 3 dimensions is used as an aid in understanding not only the seismic trace but also its relation in space. Finally, the recording not of seismic lines but of surfaces will lead us further in our understanding of the subsurface.

49534 Improvements of the geophysical exploration in the Alpine region. Echterhoff, J.; Koch, K. (Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **71/78**: 461-483(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Geophysical explorations have been carried out in the northern Alps since the early Fifties. Geological surface mapping, geoelectrics, gravimetry and reflection seismics contributed to the present knowledge of the structurally very complex region. Especially the development of the seismic data collection and processing techniques since the mid-Sixties offered the opportunity to investigate the subsurface down to the basement. Modern vibroseis techniques using computerized field recording systems along with advanced processing techniques have enhanced the results to a degree, where prospective horizons can be mapped reliably. Seismic lines, sections and maps demonstrate the improvements since the beginning of exploration. The paper concludes with an outlook on the future of exploration.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 49530, 50476, 50498

49535 (UCRL-Trans—11374) **Geophysical investigations in wells braced with pipes in the study of sections of oil and gas fields.** Petrosyan, L.G. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Yadernoj Geofiziki i Geokhimii, Moscow (USSR)). May 1978. Translated from pp 51-110, 129-134 of Geofizicheskie issledovaniya v skvazhinakh, kreplennykh trubami, pri izuchenii razrezov neftegazovykh mestorozhdenii, Nedra, Moscow, 1977. 88p. Dep. NTIS, PC A05/MF A01.

In geophysical investigations in wells braced with pipes the results are strongly affected by the casing string and the cement ring, which degrades the signal-to-noise ratio. In a number of methods the interference is so strong that no reliable information on sections can be obtained. In view of this, a complex of methods whose application can be useful for obtaining information on geophysical parameters of the formations is considered from the standpoint of shielding the signals from the interfering influence of the casing and the cement ring. In the initial and intermediate phases of the field-exploration stage, repeated investigations, as the most effective way of establishing the positions of gas-oil-water contacts, should necessarily be made in one or more wells. On the basis of such investigations it is also necessary to establish the criteria for finding these contacts from the results of large-scale geophysical work. In the final

phase of the exploration stage repeated investigations in unperforated intervals can be carried out to determine the fluid mobilities in individual types of the productive formations whose gas content has been demonstrated by sampling in wells investigated earlier. These investigations may ensure a certain reduction in the volume of sampling work, but the possibility of such a reduction should first be established at a preceding phase in the study of the field.

49536 Enhanced oil-recovery field reports. *Enhanced Oil-Rev. Field Rep.;* **4**: No. 1, 1-232(1978).

This document reports on the progress of on-going field tests of enhanced oil-recovery methods. It includes 38 update reports and three new reports. Eight projects were terminated. (DLC)

49537 Chemical scaling during water flooding. Causes and preventive measures. Kleinitz, W.; Menz, D. (Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.)). *Erdoel-Erdgas Z.;* **93**: No. 12, 428-436(Dec 1977). (In German).

From DVGI spring meeting; Clausthal-Zellerfeld, Germany, F.R. (29 Apr 1977).

75% of oil extracted in the Federal Republic of Germany is obtained from deposits where water flooding projects are taking place. 87% of the injection water is extraction water. The remaining 13% is sweet water from wells. Practice has shown that the injectivity index of boreholes, into which water was pressed, rapidly worsened after a few years which led to increasing injection pressures. It was also significant whether deposit waters were reinjected, well waters or a blend of two different waters were used. Taking the example of a water flooding project in which barium sulphate scaling occured due to mixing two waters from different sources, the following are particularly dealt with: 1) Physical-chemical causes of scaling, 2) Their deposit-specific connections as well as 3) The operational measures deduced.

49538 Oil and Gas Compact Bulletin. *Oil Gas Compact Bull.;* **36**: No. 2, 1-74(Dec 1977).

From 1977 annual meeting of the Interstate Oil Compact Commission; Santa Fe, NM, USA (4 Dec 1977).

The 1977 meeting was held in Santa Fe, N. Mexico, on Dec. 4-7, 1977; the topic was underground injection control regulations for oil and gas production. Committee reports are also included. (DLC)

49539 Development of polymers as an additive in tertiary oil recovery. Klein, J.; Martin, V.; Borkowski, N.; Klare, J.; Westerkamp, A. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Chemische Technologie). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 512-531(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

On the Development of Polymers as an Additive in Tertiary Oil Recovery - based on the relation between structure and rheology of polymers applied so far in tertiary oil recovery (polyacrylamides, polysaccharide) the concept for new synthetic polymers will be outlined. In this context the importance of 'extended chain' confirmations will be emphasized and some examples will be given to proof this concept. Electrostatic repulsion effect can be effectively only in aqueous solution. In concentrated salt solution an expansion can be maintained by incorporation of bulky, hydrophylic side groups (comb-polymers). An improved insight into the polymer floding process has to consider the relative importance of adsorption effects and some model experiments are discussed. In a system polyacrylamide-SiO_2 a monolayer adsorption of polymer coils covering all the available surface is observed. The direct analysis of polymer deposits in a porous matrix can be realized by Scanning Electron Microscopy in combination with Energy Dispersive X-Ray technique.

49540 Association and viscosity of aqueous polyacrylamide and polysaccharide solutions as polymeric flooding additives. Rehage, G.; Lange, W.; Schriewer, B. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Physikalisch-Chemisches Inst.). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 532-556(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Polyacrylamide (PAAm) of different structures have been investigated. Nonionic polyacrylamide dissolved in water - without the addition of salts - has an essential lower viscosity as hydrolysed PAAm. There is no influence on viscosity when low molecular salts are added. Experiments by electronmicroscopy show no association of the polymer molecules on the addition of low molecular salts. Solutions of ionic polyacrylamide (cationic, anionic) showed a strong reduction of viscosity when simple salts are added. Parallel to this finding an increase of the association occured. The viscosity of aqueous polysaccharide solutions remained approximately constant on the addition of simple salts. There was no increase of association observed by electronmicroscopy and light scattering measurements. Some special polymers are tested in a brine with a very high concentration of salts (200 g/l). The properties of some polysaccharides seem to be promising for purpose of tertiary oil recovery. Our results have shown that there is an important influence of association in polymer-solutions on their rheological behaviour. This could be of some importance to polymer flooding systems.

49541 Determination of residual oil saturation from geophysical well logs in tertiary recovery projects. Fertl, W.H. (Dresser Industries, Inc., Houston, Tex. (USA). Dresser Atlas Div.). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 557-574(1977).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Residual oil saturation, a key factor in the planning of tertiary recovery projects, can be determined based on reservoir engineering concepts, core data, single well tracer tests, and specialized geophysical well logging techniques. Uncertainty limits of conventional logging techniques are not too promising. However, several log-inject-log techniques using multiple repeat logging runs will determine residual oil saturation within the range of ROS^{+}-(<=5 saturation percent). Engineered planning of both logging and injection procedures is a prerequisite for reliable log-derived ROS-estimates.

49542 Water-out micellar solution for the secondary and tertiary extraction of petroleum. Dreher, K.D.; Plummer, M.A. (to Marathon Oil Co., Findlay, Ohio (USA)). German(FRG) Patent 2,365,210/B/. 23 Sep 1976. 7p. (In German).

The invention deals with the modification of water-out micellar solutions for the secondary and tertiary extraction of petroleum by a specific change in the composition. The petroleum contains water, petroleum sulphonate, hydrocarbons and a co-surfactant and/or an electrolyte. The petroleum sulphonate has a micellar solution concentration above the critical micellar concentration. By changing the solution composition one aims to obtain the greatest possible amount of petroleum using a micellar solution of about 2×10^{20} micells per litre. The petroleum suphonate has an equivalent weight of about 400 to 475, the water content of the solution is about 80 to 98 Vol.%.

49543 Process for secondary production of hydrocarbons from an underground deposit. Knight, B.L.; Rhudy, J.S. (to Marathon Oil Co., Findlay, Ohio (USA)). German(FRG) Patent 2,419,540/B/. 24 Jun 1976. 3p. (In German).

A method is described for the secondary production of hydrocarbons from an underground deposit containing formation water with a bivalent cation content of at least 500 ppm. The hydrocarbons are pressed through a flowable metasomatic mass, where properties are negatively influenced by the bivalent cations, out of the deposit and then transported above ground.

PROCESSING

REFER ALSO TO CITATION(S) 50498, 50780

49544 Hydrocarbon vapor analyzer. Edwards, R.C. (to Edwards Engineering Corp.). US Patent 4,083,227. 11 Apr 1978. Filed date 4 Apr 1977. 12p.

A hydrocarbon vapor analyzer for direct measurement of the percentage of volume of hydrocarbon vapor is a portable device utilizing two substantially identical vertically disposed graduated cylinders or burettes in which are mounted slidable and adjustable pistons for varying volumetric conditions and measuring changes in volumetric conditions of vapor mixtures of air and hydrocarbon being analyzed therein. One of the graduated cylinders defines a chamber for receiving the sample vapor mixture to be analyzed and the other provides a means for measuring the sample after it is transferred to the second burette through a device for absorbing the hydrocarbon vapor from the vapor mixture to be analyzed. The sample receiving burette has an operatively associated manifolding system which includes, an inlet valve for controlling the flow of the sample mixture of vapor to be analyzed to the sample receiving graduated cylinder, and a transfer valve for passing the vapor sample to be analyzed through the absorber for removing the hydrocarbon vapors to the graduated cylinder for measuring the net volume of hydrocarbon vapor absorbed from the sample mixture of vapor being analyzed. The respective pistons are individually slidable and adjustable by a suitable actuating device and can be set for simultaneous movement to permit controlled transfer of the sample mixture of vapor during operation of the instrument in accordance with prescribed analytical procedures for determining the percentage of hydrocarbon vapor present in the sample mixture being analyzed.

49545 Hydrocarbon conversion with a sulfided acidic multimetallic catalytic composite. Antos, G.J. (to UOP Inc.). US Patent 4,082,651. 4 Apr 1978. Filed date 25 Mar 1977. 18p.

Hydrocarbons are converted by contacting them at hydrocarbon conversion conditions with a sulfided acidic multimetallic catalytic composite comprising a combination of catalytically effective amounts of a platinum or palladium component, a rhodium component, a rhenium component, a halogen component, and a sulfur component with a porous carrier material. The platinum or palladium, rhodium, rhenium, halogen and sulfur components are present in the multimetallic catalyst in amounts respectively, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt. percent platinum or palladium metal, about 0.01 to about 2 wt. percent rhodium, about 0.01 to about 2 wt. percent rhenium, about 0.1 to about 3.5 wt. percent halogen, and about 0.01 to about 1 wt. percent sulfur. Moreover, the metallic components are uniformly dispersed throughout the porous carrier material in carefully controlled oxidation states such that substantially all of the platinum or palladium component is present therein in a sulfided state or in a mixture of the sulfided state and the elemental metallic state and such that substantially all of the rhenium and rhodium components are present therein in a sulfided state or in the elemental metallic state or in a reducible oxide state or in a mixture of these states. The sulfiding of the catalytic composite is performed prior to any contact of the composite with hydrocarbon and after substantially all or at least the platinum or palladium component has been reduced to the elemental metallic state by treatment with a sulfiding gas at conditions selected to incorporate about 0.01 to about 1 wt. percent sulfur. The resulting sulfided catalyst has the capability of diminishing undesired demethylation and other hydrogenolysis reactions during initial operation of the process and markedly increasing the overall stability of the process.

49546 Analysis of crude oil residues and deasphalted oils before and after desulphurization. Fehr, E. (BASF A.G., Ludwigshafen am Rhein (Germany, F.R.). Ammoniaklaboratorium). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 311-324(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Atmospheric residues of various provinces show different behaviour during desulphurization. These differences cannot be explained only on the basis of analytical data. Separation of the products into colloids and non-colloids before and after desulphurization supply additional analytical data, which can be used for a reasonable interpretation of the above differences. For identical operation conditions the different desulphurization rates can mainly be explained by the composition of the polar compounds in the non-colloids. Inestigation about deasphalted oils show the influence of the polar compounds on the desulphurization in the absence of the asphaltenes.

49547 Catalyst for the conversion of hydrocarbon compounds. Juguin, B.; Martino, G.; Miquel, J. (to Societe Francaise des Produits pour Catalyse Pro-Catalyse, S.A., 92 - Rueil-Malmaison). German(FRG) Patent 2,541,186/A/. 15 Apr 1976. 36p. (In German).

The present invention deals with a reformation method in the presence of a catalyst consisting of a) a carrier, b) platinum, c) at least one metal, namely rhodium or osmium and d) of at least a third additional element chosen from the following group: chromium, tungsten, molybdenum, manganese, rhenium, germanium, tin, gallium, indium, thallium, thorium, cerium, samarium, lanthanum, zinc, cadmium, titanium and zirconium.

49548 Method for the hydrogenating desulphurization of heavy oil hydrocarbons. Kubo, J.; Nomura, Hirotsugu; Kawasaki, K.; Oguchi, Y. (to Nippon Oils and Fats Co. Ltd., Tokyo). German(FRG) Patent 2,509,549/A/. 4 Sep 1975. 35p. (In German).

The invention deals with a method to catalytically desulfurize oil hydrocarbons containing distillation residual oils. The invention especially concerns the combination of a first process step, in which the oil hydrocarbons by contact with certain liquidized pretreatment catalysts are pretreated to remove the heavy metals which poison the catalysts for hydrogenating desulfurization, and of a second process step, in which the oil hydrocarbons are then subjected to a hydrogenating desulfurization by contacting these with a catalyst for hydrogenating desulfurization on a solid bed. It is understood by the term 'hydrogenating desulfurization' as used here a treatment in which hydrogen takes part in the reaction and which includes metal removal, desulfurization, denitrification, hydrogenation and hydrogenolysis.

49549 Process for the selective cracking of straight-chained and slightly branched hydrocarbons. Gorring, R.L.; Shipman, G.F. (to Mobil Oil Corp., New York (USA)). German(FRG) Patent 2,432,026/A/. 23 Jan 1975. 23p. (In German).

The invention describes a method for the selective (hydro) cracking of petroleum materials, containing normal straight-chained and/or slightly branched-chained hydrocarbons. The mixture is brought into contact with a selective, crystalline alumino silicate zeolite cracking catalyst housing a silicon oxide/aluminum oxide ratio of at least about 12 and a constraint index of about 1 to 12 under cracking conditions. A zeolite catalyst with a crystal size of up to 0.05 μ is used. Solidification point and viscosity in particular of oils are to be lowered through the catalytic dewaxing.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 49390, 49752, 49753, 50486, 50498

HEALTH AND SAFETY

49550 Offshore installations: guidance on life saving appliances. London; Her Majesty's Stationery Office (1978). 44p.

Information is presented to provide general guidance to owners of offshore installations, manufacturers of life saving appliances, Marine Surveyors, and others in relation to the provisions of the Offshore Installations (Life Saving Appliances) Regulations 1977. It should be read in conjunction with the Regulations. The guide is not fully comprehensive nor has it legal force. Sections are included on survival craft, lifebuoys, lifejackets, escape, alarms, and life saving appliances. (JRD)

49551 Can a petrol station explode. Degener, C.H. *Umsch. Wiss. Tech.;* **77**: No. 24, 798-800(Dec 1977). (In German).

Petrol, or more exactly Otto cycle fuel is an easily combustible liquid, which must be handled with care. Although petrol stations store large quantities of this dangerous fuel, and although under certain conditions there is a theoretical danger of explosion, explosion accidents are practically impossible, fortunately. The Physikalisch-Technische Bundesanstalt is concerned with the danger of explosion and protective measures in vehicle petrol stations. Due to these explosion protective measures, an explosion at a petrol station must be feared only if the prescribed safety measures are not observed, which seldom occurs.

49552 China's oil industry on an expansion course. Schickel, J. *BP Kurier;* **29**: No. 3/4, 37-39(1977). (In German).

There are contrary and unclear reports on the existing and suspected natural oil reserves, the situation in natural oil supply and the state of the natural oil industry in the People's Republic of China. Using journalistic license, the article uses data from the China Handbook of 1974 and many newspaper reports in order to show the Chinese natural oil situation and particulary to highlight the internal political influence on the economic development of the Chinese natural oil industry.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 50420, 50494, 50499

49553 (HCP/H60878—01) **Technical analysis of the international oil market.** (Petroleum Economics Ltd., London (UK)). Jun 1978. 309p. Dep. NTIS, PC A14/MF A01.

This study of the international oil market includes the changing structure of the industry, the worldwide surplus in refinery capacity and tankers, and the role of the spot market and movement of petroleum products between regions. The study shows there have been significant changes in the structure of the international oil industry in recent years. In the OPEC countries the major international oil companies have lost the power of decision-making with regard to investment, volume, and price, although their role in downstream activities in the major industrial consumer countries remains substantial. At the same time as the control levers of oil supply have passed into OPEC hands, the USA has increased its dependence on foreign oil supplies up to almost 50 percent of demand. Unless either greatly increased efficiency of energy use can lead to a substantial reduction in energy demand growth—or higher energy prices cannot be absorbed by the economic system, resulting in a prolonged period of recession—constraints are likely to exist in energy supplies some time before the mid-1980s, bringing about a substantial increase in oil prices in real terms. Such a situation will call for careful management by all concerned—consumers and producers, government and industry—if competitive bidding for available supplies is to be avoided and economic activity is not to be affected. Monitoring the evolution of supply developments would be an important adjunct of policymaking. This would necessitate keep-

ing a close track of world energy and oil supply/demand developments on a broad regional basis at regular (e.g., quarterly) intervals.

49554 (TID—28527) **Oil and gas boiler tax impact analysis.** (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). [nd]. Contract EM-77-C-01-8739. 4p. Dep. NTIS, PC A02/MF A01.

The National Energy Plan (NEP) contains proposals for a wellhead tax, which would increase the price of domestic crude oil to world levels, a natural gas pricing policy which would gradually allow the price of gas to rise to the equivalent of oil, a number of conservation incentives, regulation of new fuel burning facilities, and a package of oil and gas user taxes with tax rebates and credits for investments made by industry in the process of converting facilities from oil and gas to coal. The pre-conversion or short-run impacts of the oil and gas tax are addressed; post-conversion or longer-run impacts are not examined. Principal attention is placed on the impacts of the rise in energy costs due to the oil and gas boiler tax. The general analytical approach taken can hence be described as one of partial equilibrium which focuses on each industry at a time, assuming that impacts are highly localized and the rest of the economy remains largely unaffected. Further analysis, taking a general equilibrium approach, would consider impacts simultaneously on all industries, by taking into account the interdependence of all industries during a process of transition to alternative energy user patterns and technologies. The analysis of the short-run economic impact of the oil and gas boiler tax, where attention is focused on the effects of an upward shift in the variable (operating) costs of the firms in the industry, is analogous to an analysis of the incidence of an excise tax. Of central importance in this connection would be the simultaneous consideration of both supply and demand elasticities. The reports take into account these analytical considerations qualitatively to the extent practicable.

49555 **National economy and energy industry. Europe's uneconomical oil markets.** *Glueckauf;* **113**: No. 21, 1011-1013(Nov 1977). (In German).

The situation of the petroleum companies operating in Western Europe is analyzed in detail. The three main problems are: 1) Excess capacity in oil refineries. 2) Differences between refinery production and the demand for oil products. 3) Effects of newly-founded, export-oriented refineries in the OPEC countries on the EC market.

49556 **Problems of competition in mineral oil industry.** Schuermann, H.J. (Koeln Univ. (Germany, F.R.). Energiewirtschaftliches Inst.). *Kohle Heizoel;* **30**: No. 9, 4-12(Sep 1977). (In German).

This is an abridged version of the study 'concentration and competition in the electric power industry', set up by the Energiewirtschaftliches Institut of the University of Cologne. As the German primary energy supply depends on foreign countries to more than 60%, it was necessary to take the international aims and decisions into consideration. There are more or less intensive substitutional relations between the individual energy sources which are also taken into consideration in the market analysis. Some essential results concerning the structure of the offering side and the concentration processes within the mineral oil industry are commented on, as these are of fundamental importance for market research, also in the future.

49557 **California oil and natural gas imports.** *Calif. Geol.;* **30**: No. 3, 61-62(Mar 1977).

Statistics are given for the sources of crude oil and natural gas used in California in 1975 and 1976 (estimated). Proved oil reserves in California in 1976 were 4.8 billion barrels, exclusive of Federal offshore reserves; gas reserves were 5.6 billion Mcf. (DLC)

49558 **Monthly petroleum statistics report, March 1977.** Washington, DC; Federal Energy Administration (1977). 22p. (FEA/B—77/175).

A summary table is given of U.S. petroleum industry operations. Data are given on: petroleum imports, crude runs-to-stills, motor gasoline stocks, distillate fuel oil stocks, refinery operations, production of petroleum products, primary stocks. (DLC)

49559 **Monthly petroleum statistics report, May 1977.** Washington, DC; Federal Energy Administration (1977). 22p. (FEA/B—77/221).

Besides a summary table on petroleum industry operations, this report also includes data on: petroleum imports, crude runs-to-stills, motor gasoline stocks, distillate fuel oil stocks, refinery operations, production of petroleum products, and primary stocks. (DLC)

49560 **Monthly petroleum product price report, January 1977.** Washington, DC; Federal Energy Administration (1977). 19p. (FEA/B—77/188).

This report provides national weighted average prices of petroleum products on a monthly basis at different levels of the marketing chain. The prices (including taxes) reported by refiners, gas plant operators, and large resellers/retailers cover the period July 1975 to Dec. 1976; the gasoline and diesel prices (including taxes) from a survey of retail outlets cover Jan.-Dec. 1976; and the heating oil prices cover June to Dec. 1976. (DLC)

49561 **Oil trading service purchase of oil from Iran.** London; Her Majesty's Stationery Office (1976). 10p.

A statement is presented of the United Kingdom accounts of trading and profit and loss for the periods from 1st February 1974 to 31st March 1975 and from 1st April 1975 to 26th September 1975 and a balance sheet as of 31st March 1975 with respect to income and expenditure by the Department of Energy in connection with the purchase of oil from Iran. The reports of the Comptroller and Auditor General on these accounts are included.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 51134

49562 **Water and waste water in the mineral oil and petrochemical industry. Present state and tasks.** Breitling, V. (Deutsche Marathon Petroleum G.m.b.H., Burghausen (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 94-102(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Engineering progress regarding the waste water purification and especially the economical usage of water has led to the fact that since 1969 the load of the receiving stream by waste waters coming from the Petroleumndustry has decreased although the throughput of crude oil has increased. Serious operating problems regarding waste water treatment are non-existent. Waste waters do no longer essentially contribute to the contamination of the surface water. Nowadays ground waters, surface waters as well as the oceans are mainly endangered by the huge transportation capacities, transshipments, and storage of crude oil and its products. Therefore it is most important to take effective preventive measures to avoid accidents and to carefully collect wastes. Here are still some problems to be solved which are of interest to the industry and many other groups. Research work in this field is therefore carried out at these companies and with their help at the DGMK, CONCAWE and in numerous Research Institutes. Results are available to all parties involved and interested.

49563 **Mixture and method to remove petroleum residues by biological degradation.** Fusey, P. German(FRG) Patent 2,227,840/C/ . 18 Nov 1976. 3p. (In German).

The petroleum residues are converted for aerobic degradation by microorganisms into a stable suspension as follows: 100 parts by weight of the petroleum residue to be treated are mixed with 70-200 parts by weight of a mixture of 40-60% bottom product, 0-12% ammonium nitrate, 3-8% dicalcium phosphate, 25-40% calcium carbonate and 1-3% glue. This mixture is diluted with 10-30-fold of its weight of water and the thus obtained stable emulsion is aired. The added bottom products, even distillation residues, are cheap sources for nitrogen and trace elements which are necessary as nourishment for micro-organisms, as well as the amounts of ammonium nitrate, dicalcium phosphate and calcium carbonate. The glue serves as biologically degradable emulsifier to stabilize the emulsion so that one can do away with a mechanical disperser.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 51012, 51061, 51087, 51319

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 49554, 50494, 50499, 50500

49564 **Petroleum and Submarine Pipe-lines Act 1975.** London; Her Majesty's Stationery Office (1976). 9p.

This memorandum explains the scope and operation of the new controls of this act over refinery projects. (The term Refinery is defined to be a crude oil distillation plant.) (DLC)

49565 **Offshore Energy Technology Board: strategy for research and development.** London; Her Majesty's Stationery Office (1976). 19p.

The strategy that the United Kingdom Offshore Energy Technology Board (OETB) has advised the Department of Energy to pursue in sponsoring research and development in the field of

offshore oil and gas technology is outlined. The views presented have evolved following a number of detailed discussions on many individual topics by the Board in the course of its work during the last year. The information is presented as an aid to more general debate and to draw to the attention of firms operating in this area the opportunities for Government support of research and development programs.

49566 United Kingdom offshore oil and gas policy. London; Her Majesty's Stationery Office (1974). 9p.

The policy is outlined in five proposed Government actions. These actions involve imposition of tax on offshore operations, optional Government ownership or part ownership of the oil or profits, ensuring fairness to oil companies, establishment of a national corporation to represent the Government, and extending Government powers to control production and pipelines. (JRD)

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 49544, 50495, 50496, 50498, 50666

49567 Reloading station for refuelling or unloading ships transporting liquids. Westra, S. (to Shell Internationale Research Maatschappij N.V., The Hague (Netherlands)). German(FRG) Patent 1,939,013/B/. 8 Jun 1977. 5p. (In German).

At places where there is no port equipment for the re-loading of liquids, ships are made fast to buoys in the roadstead, which are connected by pipelines to the land. The pipeline has a flexible connection to the buoy on the one hand and is connected to a flexible floating hose on the other. In order to reduce the wear on the expensive hoses caused by bending due to waves, the pipe kneepiece is to be taken underwater to the buoy by the adjacent part of the hose, in order to reduce buoancy, and the rest of the hose only is to be made to float by retaining a small amount of bending.

49568 Alaska pipeline was a new ground for technicians and economists. Kuhn, W. *BP Kurier;* **29**: No. 3/4, 3-7(1977). (In German).

Possible alternative solutions for oil transport from Prudhoe Bay in the Arctic Ocean, pipeline projecting, and problems of the layout of the line as well as the laying technique used are reported on in easily intelligible form.

49569 Distribution plant for distributing a liquid gas obtained from mineral oil in the gas phase. Bonart, J.L. (to Shell Internationale Research Maatschappij N.V., The Hague (Netherlands)). German(FRG) Patent 2,525,584/A/. 18 Dec 1975. 15p. (In German).

A distribution plant for distributing a liquid gas obtained from mineral oil in the gas phase is described, with a main storage container for a liquid gas obtained from mineral oil, a main distribution circuit between the roof of the main storage container and the consumers, with one feed pipe with a main pressure reduction valve set to a certain pressure. A secondary distribution circuit is present, to which the liquid gas obtained from mineral oil can be transmitted to the consumers in the gas phase and at sufficient pressure, if the temperature conditions in the vicinity of the storage container do not normally permit extraction in the gas phase via the main distribution circuit.

PROPERTIES

REFER ALSO TO CITATION(S) 49416, 49546, 49607

49570 Determination of sulfur content in fuel oils by radioisotopic, energy dispersive X-ray fluorescence spectrometry. Magrini, A. (Rome Univ. (Italy). Facolta di Ingegneria); Salmi, M. (Calabria Univ., Catanzaro (Italy). Dipartimento di Fisica). *Kerntechnik;* **20**: No. 2, 94-95(Feb 1978).

The method proposed here for sulfur content determination in fuel oils shows the following advantages when compared with the alternative methods mentioned in the Book of ASTM Standards: the instrumentation cost is low (ca. US-$ 5000); a short time is required for each determination (500 s); measurements can be made directly within the industrial installation in on-line control; the measuring procedure is very simple and does not require a specially qualified operator; finally the radiation and contamination risk is very low. The minimum detectable limit obtainable with the prototype described is 0.15% in wt (95% confidence level). The precision varies from 0.08 to 0.11% in wt (95% confidence) within the sulfur concentration range of interest (0...4% in wt).

STORAGE

REFER ALSO TO CITATION(S) 51302

49571 (DOE/RA—0032/3) **Expansion of the strategic petroleum reserve. Amendment No. 2, Energy Action DOE No. 2.** (Department of Energy, Washington, D.C. (USA)). Jun 1978. 554p. Dep. NTIS, PC A04/MF A01.

The Energy Policy and Conservation Act (EPCA), signed into law on December 22, 1975, authorized the creation of a Strategic Petroleum Reserve (SPR). The objective of the SPR is to provide for the storage of substantial quantities of petroleum in order to diminish U.S. vulnerability to the effects of a severe petroleum supply interruption. The SPR Plan was transmitted to the Congress as Energy Action No. 10 on February 16, 1977, and became effective April 18, 1977. Subsequently, to accelerate the development schedule, Plan Amendment No. 1 was transmitted to the Congress as Energy Action No. 12 on May 25, 1977, and became effective on June 20, 1977. The purpose of this SPR Plan Amendment is to expand the ability of the SPR to protect the United States against supply shortages. The Amendment is to provide for the expansion of the Reserve size from 500 million barrels (MMB) to 1000 million barrels; and provide an implementation plan for the third 250 MMB. The Amendment describes a proposed change to the program and discusses the required implementation activities as well as the benefits and costs of the actions. It also assesses the relevant economic and environmental impacts that would result from implementation. The Amendment does not consider the question of whether or not regional storage should be provided for the East Coast or whether noncontiguous storage should be provided in the State of Hawaii or in Puerto Rico. A reexamination of regional and noncontiguous storage is under way within DOE. The results of these reexaminations will be reported to the Congress.

49572 New method for seasonal storage of mineral oil products in caverns making use of the expansion of gas cushions. Roehr, H.U. (Deutsche Texaco A.G., Hamburg (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 638-655(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Cavern projects intended for the storage of stockpiles can only be utilized within very narrow limits. Withdrawal of the products by displacement with fresh water is only possible to a certain degree. The use of submersible pumps is restricted to caverns located at relatively shallow depths. The brine used for displacement is only available until the caverns are completed. Big brine basins may not be built in some places according to the regulations of ground water and environmental protection. A new procedure is proposed in this paper. The brine is stored in caverns together with a gas cushion. This cushian is compressed during the injection of brine. Brine withdrawn is rendered possible by expansion of the gas cushion. From the rock-mechanical conditions, the depth-dependent maximum gas pressure and the required minimum pressure, equations are derived for determination of the required cavern volume, pump pressure and compression ratio. The optimum solution is considered and the suitability of air and natural gas for use as cushion gas is discussed in connection with the process of filling the caverns for the first time. The special advantage of this method lies in the fact that caverns located at great depths as well as very irregularly shaped caverns can be used for seasonal storage. The additional investments required for this purpose are very low as compared with surface storage tanks, so that profitability is soon ensured, if additional storage volume is required. The profitability can still be increased by combining gas and oil storage cavern operation.

COMBUSTION

49573 Influence of the gas recirculation on NO formation with heavy oil combustion. Krutiev, V.A.; Efendiev, T.B. *Arch. Energiewirtsch.;* **32**: No. 1, 7-12(Jan 1978). (In German).

The utilization of forced flue gas recirculation is to be recommended despite various disadvantages (rise in capital expenditure for boiler construction), increase in electric energy requirements, practically limited flue gas recirculation for superheated steam regulation. NOX emission is efficiently reduced (2 to 2.5 times) by forced flue gas recirculation. The material behavior of the heating surfaces generating steam is made release, due to the reduction of falling heat flows.

49574 Additives and the effects which they can achieve in oil-fired installations. Meurer, J.D. (Helling und Co., Hamburg (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 205(Oct 1977). (In German).

Heating oil quality will vary over a greater range in the future due to its increasing scarcity. The disadvantageous effect on combustion can be compensated for by a good additive, together with improvement of the oil-fired installations. An improvement of combustion and a reduction of soot formation is achieved by the heating oil additive 'Bycosin', which contains organometallic compounds, and whose particle trials over many years are described.

NATURAL GAS

REFER ALSO TO CITATION(S) 49526, 50497

RESERVES

REFER ALSO TO CITATION(S) 50476

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 49529, 49532, 49533, 49598, 49600, 50476

49575 (TID—28377) **Quarterly technical progress report No. 6, January 1978—March 31, 1978.** Struble, R.A. (Ohio Dept. of Natural Resources, Columbus (USA). Div. of Geological Survey). 1978. Contract EY-76-S-05-5200. 14p. Dep. NTIS, PC A02/MF A01.

This quarter the Division's program in all areas of the integrated proposal is under way at different stages of progress. The areas of clay mineralogy, petrology and geochemistry are the farthest advanced and data is being generated in these areas daily. Clay mineralogy data has been completed on both of the cores supplied by MERC, R-109 and the Glen Gery No. 5-745, and the Chillicothe Test Core, S-970, on file at the Division. The geochemical phase of the project is also fully operational and data is being generated daily. Most of the work on samples from MERC R-109 and the Chillicothe Test Core (OGS-S-970) has been completed and sample splits from core MERC (Glen Gery No. 5-745) and the Barberton Core (OGS-S-3370) are available for geochemical analysis when analytical work on core (R-109 and Glen Gery No. -745) is completed. In the stratigraphic phase of the project the Division has been able to meet nearly all of the USGS and EGSP requests for deliverables even though much of the data have been preliminary in scope. Work is continuing slowly on the fracture analysis phase of the project. This phase of the project is behind schedule. The problems surrounding recruitment of personnel for the project have diminished since most of the vacant positions are filled and the principal investigator should be able to devote a great deal more time to the fracture analysis phase of the project. This phase of the project is behind schedule but in the next quarter the work output should meet the projected work schedule. No problems are anticipated in the continuation or completion of this phase of the project.

49576 (TID—28433) **DOE Eastern Gas Shale Project. Quarterly report of technical progress, January—March 1978.** Piotrowski, R.G.; Harper, J.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1978. Contract EY-76-S-05-5198. 2p. Dep. NTIS, PC A02/MF A01.

A Penetration and Show Map (Task 3200-1-2) and a Drilling Depth Map (Task 3200-5-3) both at a scale of 1:250,000 have been completed and a camera ready copy sent to DOE, Morgantown, WV. Work on nine stratigraphic cross-sections (Task 2100-1-1) is complete. One section is in camera ready form and has been sent to DOE, Morgantown, WV. Drafting on the remaining cross-sections is proceeding. A Structure Map on the top of the Onondaga at a scale of 1:250,000 has been completed and awaiting drafting. Data collection for all other maps: Isopach Maps (Task 2100-1-2), Structure Maps (Task 2100-2-1), and Lithofacies Maps (Task 2100-3-1) is proceeding. Data have been collected for eighty-five, 15 minute quadrangles which is approximately 80% of the study area. A total of 430 wells have been tied into the stratigraphic framework to date. Delays in the delivery of products has been due to drafting problems which resulted from a lack of drafting formats for cross-sections and maps from DOE. All other work is on schedule.

49577 Ultra deep exploration in the Federal Republic of Germany. Weggen, K. (Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.)). *Erdoel-Erdgas Z.;* **94**: No. 1, 8-15(Jan 1978). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

The reserves of natural gas in the today's producing horizons will be explored and are expected to decrease relatively quick in the Federal Republic of Germany in the near future. Supported by the government the German oil companies have explored for a long time Devonian and Lower Carboniferous in North-Germany and the basis of Tertiary and Upper Jurassic in the Bavarian Alpes. Exploration had already started with the wildcats Muensterland 1, Versmold 1 and Solling 1 between 1962 and 1970. Following the Solling 1 exploration was continued only by seismic and geological surveys until the so-called 'Martini-Programm' became effective. After the governmental directives had passed, the oil companies were prepared to name several projects. The first wells Velpke-Asse-Devon 1, Moelln-Tief 1 and Miesbach 1 had to be abandoned before reaching their target because of technical reasons. The preparation of a second Devonian project was not successful. In the Alpes exploration continues by drilling a wildcat Vorderriss 1 and by seismic. Because of the overdeep wells and technical difficulties caused by geological problems the exploration is supported by the government.

49578 Hydrates of natural gas. Makogon, Yu.F. Denver; Geoexplorers Associates, Inc. (1978). 178p.

Translated from Russian by W. J. Cieslewicz.

Research was conducted on hydrate gas, particularly on the conditions of its formation in permafrost strata and in pipelines operated under Arctic conditions. This book contains six chapters entitled: study of hydrate properties and occurrences; problems of hydrate kinetics; preventing the formation of hydrates; hydrate deposits in porous rock strata; theoretical principles of gas production from hydrate fields; and utilization of hydrates. 57 references, 30 tables, 115 figs.

49579 Generation of hydrocarbon gases in modern sedimentary volcanogenic-sedimentary formations of the eastern and southern parts of the Atlantic Ocean. Veber, V.V. *Int. Geol. Rev.;* **19**: No. 12, 1399-1403(Dec 1977).

Translated from Geologiya Nefti i Gaza: No. 1, 59-64(1977).

We have studied the phenomena of modern gas formation based on data from volcanogenic-sedimentary formations in the southern part of the Atlantic Ocean and carbonate sediments of its eastern part, and also the terrigenous sediments of the Scotia Sea. A wide range of sedimentary facies has been established, in which the regular generation of gaseous hydrocarbons (including those heavier than methane) takes place.

49580 Isotope ratios of nitrogen from deposits of natural gas north of the Voralpenland. Wollanke, G. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Chemische Technologie). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 339-363(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

After studying the geochemical behaviour of nitrogen the isotope ratios of this component in the natural gas in northern and southern Germany will be discussed. The gas from the Westmolasse, Ostmolasse, and Austrian Molasse each form a group depending on the nitrogen isotope ratios in which the individual reservoir rocks of different formations differ from each other. The reported results will be compared with data from northern Germany.

49581 C and H isotope analysis in natural gases of the Southern German molasse in order to determine its origins. Schoell, M. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 364-379(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

In the subalpine tertiary basin east of Munich occur dry gases in chattian and aquitanian strata ($C_2/C_1 <= 1/100$). The methane in these gases is depleted in ^{13}C(delta ^{13}C approximately-70‰). The nearer to the tertiary basis the reservoirs are, the more enriched are the gases in C_2 and ^{13}C in the methane. It is concluded that bacteriogenic gases migrate with pore waters to the tertiary basis and mix in eocene reservoir rocks with gases of thermocatalytic origin.

49582 Isotope techniques in hydrocarbon exploration. Faber, E.; Stahl, W. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 380-391(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Isotope analyses have been used in the past as a mean of elucidating the origin of natural gas in already producing fields. In addition, carbon isotope analyses can be used to correlate and

evaluate exploratory boreholes during drilling. Analyses of trace amounts of methane desorbed from cuttings can give the origin and history of the organic matter being drilled. Isotope analyses on different molecular-type fractions (i.e. aliphatics, aromatics, heterocyclics, etc.) extracted from country rock or separated from crude oils can also yield important exploration information through oil/oil or oil/kerogen correlations. Applications of these methods are given in examples taken from offshore drillings located in the British North Sea and near Thailand and Trinidad.

49583 Depth exploration in the Federal Republic of Germany. Weggen, K. (Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 392-405(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

The reserves of natural gas in the today's producing horizons will be explored and are expected to decrease relatively quick in the Federal Republic of Germany on the near future. Supported by the government the German oil companies have explored for a long time Devonian and Lower Carboniferous in North-Germany and the basis of Tertiary and Upper Jurassic in the Bavarian Alpes. Exploration had already started with the wildcats Muensterland 1, Versmold 1 and Solling 1 between 1962 and 1970. Following the Solling 1 exploration was continued only by seismic and geological surveys until the so-called 'Martini-Programm' became effective. After the governmental directives had passed, the oil companies were prepared to name several projects. The first wells Velpke-Asse-Devon 1, Moelln-Tief 1 and Miesbach 1 had to be abandoned before reaching their target because of technical reasons. The preparation of a second Devonian project was not successful. In the Alpes exploration continues by drilling a wildcat Vorderriss 1 and by seismic. Because of the overdeep wells and technical difficulties caused by geological problems the exploration is supported by the government.

49584 Geology and hydrocarbon potential of the lower carboniferous limestone and the namurian in Northern Germany. Pflanzl, G. (Mobil Oil A.G., Celle (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 406-433(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

In the main parts of the North German sedimentary basin the Lower Carboniferous has not yet been reached by wells. According to paleogeographical and tectonical evaluations, based on the geology of the surrounding areas, the Lower Carboniferous may be present in the facies of Carboniferous limestone. Favourable reservoir parameters may even exist at great depths, where the Carboniferous limestone is expected to be burried. Geophysical data are poor and do not give a reliable interpretation. The exploration of the Carboniferous limestone is very costly and a high risk venture. The exploration of the Namurian is subjected to similar conditions as the exploration of the Westfalian, but the deteriorating influences of depth and methamorphism on the reservoir quality are stronger.

49585 Aspects of potential hydrocarbon deposits in the devonic reefs of Northern Germany. Krebs, W. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Geologie und Palaeontologie). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 434-436(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 49543, 50476

49586 Potential for increasing production of natural gas from existing fields in the near term. Washington, DC; National Academy of Sciences (1978). 119p. $6.25.

Six fields in the federal leases in the Gulf of Mexico were studied to assess the potential for increased production: Tiger Shoal, East Cameron Block 64, Eugene Island Block 266, Vermilion Block 14, South Marsh Island Block 48, and East Cameron Block 271. This report summarizes the detailed studies of these fields, discusses important issues raised in the analyses, and draws some general conclusions about accelerating gas production from existing fields in the near term. The primary conclusions are: (1) of the six fields, only the Tiger Shoal field offers significant opportunities for physically increasing production from proved reserves in the near term; (2) with one exception (Tiger Shoal), the fields have significantly smaller reserves than the USGS estimates; (3) if the production histories of the fields are typical, existing fields in the Gulf of Mexico Outer Continental Shelf appear to offer negligible prospects for increased production in the near term. (DLC)

49587 Construction and start up of the SELEXOL natural gas purifying plant Dueste II of Wintershall AG. Woelfer, W. (Wintershall A.G. Erdoelwerke, Barnstorf (Germany, F.R.)). *Erdoel-Erdgas Z.;* **93**: No. 12, 421-427(Dec 1977). (In German).

From 27. Canadian chemical engineering conference; Calgary, Canada (23 - 27 Oct 1977).

The use of the SELEXOL Process for the selective removal of hydrogen sulfide from Natural Gas is shown for example in the Duese II plant of Wintershall AG, Federal Republic of Germany. Included in the Dueste II installation is a three reactor Sulfur Recovery Unit. Besides the general philosophy for choosing this particular process, some variations of the SELEXOL Process and also examples of operational experience and data will be given.

49588 Safety equipment for early detection of the stress corrosion susceptibility, especially in natural gas treatment plants. Rubo, E.; Rogge, K.; Hobler, A. (to Davy Powergas G.m.b.H., Koeln (Germany, F.R.)). German(FRG) Patent 1,958,150/B/. 16 Jun 1977. 5p. (In German).

The invention proposes equipment which enables one to detect the stress corrosion susceptibility of pressurized bodies in good time. In particular, the safety in operation of natural gas processing plant, which work with chemically aggressive pressure media (e.g. damp HS). is to be guaranteed. Parts of the equipment which are endangered are made of material which is particularly corrosion-susceptible (e.g. thin metal wall thickness, faulty weld quality) and are then surrounded by a double wall of better quality material. Measuring equipment to indicate leaks is installed in the annular space. If stress corrosion occurs, the whole plant can be examined regarding material qualities without interrupting operation. Further claims describe the configuration of these zones and measuring processes.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 49390

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 49550

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 49554, 49557, 50420

49589 Present problems of the gas industry. Glaeser, F. *Gas-Wasserfach, Gas-Erdgas;* **119**: No. 1, 4-7(Jan 1978). (In German).

From Discussion meeting of the gas industry; Mainz, Germany, F.R. (10 - 11 Nov 1977).

Present problems of the gas industry are dealt with. Energy conservation and environmental protection due to the use of gas are mentioned as well as the competitive situation. Finally, pricing and the reform of the gas regulations are discussed, and a few remarks are made concerning the future availability of natural gas.

49590 Long-distance supply of natural gas in the USSR. Kett, U. (Technische Werke der Stadt Stuttgart A.G. (Germany, F.R.)). *Gas-Wasserfach, Gas-Erdgas;* **118**: No. 12, 547-548(Dec 1977). (In German).

From Congress of the International Gas Union; Prague, Czechoslovakia (6 May 1977).

The article describes the most important long distance natural gas supply projects in the USSR from the point of view of the export of gas to countries to the west of the USSR. After an introductory description of the overall position, several individual projects for export of gas to Poland, Czechoslovakia, East Germany, Bulgaria, Hungary as well as the FRG, France, Italy and Austria are dealt with in detail. Finally the transport of export gas from Iran and the joint project 'Orenburg gas condensate field' are described.

49591 Market for natural gas - problems of price formation - comments on an expertise on monopoly. Dolinski, U. (Deutsches Inst. fuer Wirtschaftsforschung, Berlin (Germany, F.R.)). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 12, 531-540(Dec 1977). (In German).

The article at hand is to be seen as an extract from an investigation carried out by the German Economic Research Institute on reproaches against the gas industry brought forward by the monopoly commission. The investigation has resulted in the fact that the German Economic Research Institute categorically objects to

the creation of a central energy board to review, control and approve prices, as well as to control investment, depreciations, and interest return as proposed by the monopoly commission. According to the institute, the changes desired by the monopoly commission would result in a removal of the gas industry from the energy market, which would mean to relinquish the realization of objectives of energy policy, i.e. safety, environmentalness and cheapness of energy supply.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 49538

49592 (UCRL—50036-78-1) **LLL Gas Stimulation Program. Quarterly progress report, January—March 1978.** Hanson, M.E.; Anderson, G.D.; Shaffer, R.J.; Montan, D.N.; Haimson, B.; Cleary, M.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Apr 1978. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

Research and accomplishments of the LLL Gas Stimulation Program during the second quarter of fiscal year 1978 is summarized. Hydraulic fracturing models were developed and applied, and some calculations of the local and distant effects of the hydraulic fracturing process have been performed. Analyses of the surface deformation effects in a layered medium above a hydraulic fracture have been completed. Some of these results are included, and a report outlining detailed findings is in preparation. A theoretical and laboratory analysis is being conducted of the effects of layering and interfaces on the hydraulic fracturing process. Early results indicate that the stress concentration factors at the tips of a pressurized fracture across an interface are significantly affected by the differences in the mechanical moduli on either side of the interface. Additionally, the frictional characteristics of the interfaces strongly affect propagation across the interface. Theoretical dislocation models are being advanced for application to problems related to crack propagation across an interface. Experiments are being pursued to determine the effects of principal stress magnitudes on the orientation of a hydraulic fracture in porous basalt. Pressure test data taken by Mobile Research and Development Corporation and DOE at a Piceance Creek MHF-stimulated well (unit Well F31-13G) was analyzed that shows fairly good flow rates. The analysis indicates relatively short fracture wing lengths in the production reservoir rock and damage by the fracturing fluid on the fracture faces.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 49554, 49565, 49566, 50501

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 50666, 50667

49593 (FEA/T—77/287) **Report of the working group on supply, demand and energy policy impacts of Alaska gas.** (Federal Energy Administration, Washington, D.C. (USA)). 1 Jul 1977. 185p. Dep. NTIS, PC A09/MF A01.

A detailed supply-demand analysis of an Alaska gas project by itself is presented constituting an extension of a comment on the findings of the Federal Power Commission (FPC). An Alaska gas project in the context of the NEP is considered. Alternative uses of the Alaska gas resource in the event that one of the proposed transportation systems is determined to be in the national interest are discussed.

49594 General considerations to be observed in long-term pipe grid renewals. Kottmann, A. *Gas- Wasserfach, Gas-Erdgas;* **119**: No. 1, 25-31(Jan 1978). (In German).

From Discussion meeting of the gas industry; Mainz, Germany, F.R. (10 - 11 Nov 1977).

The renewal of existing pipelines in old systems is a considerable expense in gas distribution. A drawing method is introduced for the determination of long term renewal rates. Various influences, such as 'different duration of use' and 'early renewal' can be simply taken into account. This method represents an opportunity for the manager to control pipework replacement with the aim of economic and safe operation.

49595 Gas supply in Switzerland. Lauer, K.H. (Technische Werke der Stadt Stuttgart A.G. (Germany, F.R.). Abt. Fernwaermevertrieb). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 12, 550-551(Dec 1977). (In German).

From Congress of the International Gas Union; Prague, Czechoslovakia (6 May 1977).

A short overview of the historical development of the Swiss gas industry is given from the first coal gas production in Bern in 1843 to the present stage of natural gas supply. Here too the first imports of natural gas brought about a surge in demand, which then led to the construction of the transalpine natural gas pipeline from Holland to Italy, and from which large quantities of gas are tapped off into the Swiss gas supply network. Further import contracts were concluded, which produced a jump in gas sales between 1971 to 1975 to treble the original amount. The construction of the gas transport network necessary for distribution made great technical demands, including laying pipes at heights of up to 2,500 metres and 310 metres below Lake Geneva.

49596 Development of the conveyance of gas over long distances in Czechoslovakia. Lauer, K.H. (Technische Werke der Stadt Stuttgart A.G. (Germany, F.R.). Abt. Fernwaermevertrieb). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 12, 549-550(Dec 1977). (In German).

From Congress of the International Gas Union; Prague, Czechoslovakia (6 May 1977).

A short survey is given of the development of the gas economy in Czechoslovakia, starting with the first gas works in Prague in 1845 to the most modern transport systems for natural gas. There are now two supply systems, one on a towns gas basis, which is mainly obtained from Lurgi pressurised gasification plants from lignite, and one on a natural gas basis. The natural gas is largely imported from the USSR. Czechoslovakia has also become very important as a transit country for natural gas supplies from the USSR to the FRG.

49597 Gas gathering pipeline systems in the North Sea. London; Dept. of Energy (1976). 8p.

The background to the work on a gas gathering pipeline is reviewed and the next tasks to be performed are outlined. The Government has decided to establish a company, Gas Gathering Pipelines (North Sea) Ltd., to perform these tasks. The studies are intended to reach a definitive conclusion and the company will be asked to submit an initial report, with recommendations, by 31 December 1977 updated by the end of March 1978. To enable the study company to start work on planning studies, British Gas Corporation (BGC) and British National Oil Corporation (BNOC) have agreed immediately to establish the study company. BGC and BNOC will jointly establish the company of Gas Gathering Pipelines (North Sea) Ltd. The Government wishes a significant minority to be held by the private sector as the third partner.

PROPERTIES

REFER ALSO TO CITATION(S) 49416

49598 Extraction and analysis of volatile hydrocarbons (C_2-C_7) contained in rocks using an elution method in the flow of a capillary gas chromatograph. Schaefer, R.G.; Leythaeuser, D.; Weiner, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe fuer Erdoel und Organische Geochemie). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 209-215(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Light hydrocarbons in the C_2-C_7 molecular range are extracted from rocks and analysed by placing the sample into the flow system of a capillary gas chromatograph. The eluted compounds are collected in a pre-column cold trap. Splitless GC analysis is performed isothermally employing s.c.o.t. capillary columns. For this technique only a small sample size (ca. 1 g) and a relatively short analysis time (less than 30 min for the complete boiling range including toluene, 33 compounds) are required. A back-flush technique enables the removal of higher boiling components during the analysis. Compound identification is carried out by means of KOVATS retention indices.

STORAGE

REFER ALSO TO CITATION(S) 51302

49599 Investigations made into the gas volume delivered in the winter, using long-term temperature patterns with a view to designing and calculating appropriate storage capacities and peak-shaving units. Duewel, G. (Hamburger Gaswerke G.m.b.H. (Germany, F.R.)). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 12, 540-547(Dec 1977). (In German).

From Discussion meeting of the gas industry; Mainz, Germany, F.R. (10 - 11 Nov 1977).

Starting from natural gas sales in 1975/76 for the example of Hamburg, the necessary volume of the underground storage is determined on the basis of regression line of 1975/76 for a normal winter and for a cold one in the year of reference. The corresponding volumes for a normal winter and for a cold one in 1985/86 are extrapolated. While considering the referential conditions of the capacities of the underground storage and of the gas tanks, taken as an example the gas works of Hamburg, it is pointed out how the volume (m^3/h) is to be designed in the future.

OIL SHALES AND TAR SANDS

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 49575

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

49600 (ORO—5203-3) **Geologic and geochemical studies of the New Albany Group (Devonian black shale) in Illinois to evaluate its characteristics as a source of hydrocarbons. Quarterly progress report, October 1—December 31, 1977.** Bergstrom, R.E.; Shimp, N.F. (Illinois State Geological Survey, Urbana (USA)). 1977. Contract EY-76-C-05-5203. 27p. Dep. NTIS, PC A03/MF A01.

Results of geologic and geochemical studies of the New Albany Group in Illinois are presented. Information is included on the lithology, stratigraphy, and structure of the New Albany Group. Work directed at characterizing the mineralogic and petrographic properties of this Group is summarized along with results of studies on the physical properties of black shales and studies of elements in Eastern U.S. shales. (JRD)

DRILLING, FRACTURING, AND MINING

49601 **UK oil shales: past and possible future exploitation.** Mathews, A.F.M. London; Her Majesty's Stationery Office (1975). 20p. Pound 1.15 net.

A study was made to consider the prospects for a resumption of the shale oil industry in Scotland and the likelihood of being able to start up the industry, not only in Scotland but elsewhere in the United Kingdom, on an economic basis given current techniques and economic conditions, and to consider under what changed circumstances (including the world price of oil and the introduction of new techniques) economic production would be feasible. It is concluded that it is not appropriate to resume exploitation of shale in Britain in the foreseeable future, by reason of the availability of alternative hydrocarbon sources which are industrially and environmentally preferable. In the long term, however, the possible importance of the British shales to overall energy planning seems to merit some continuing attention.

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

49602 (FE—2346-26) **Energy from in situ /processing of antrim oil shale. Monthly technical progress report for April 1978.** Humphrey, J.P. (Dow Chemical Co., Midland, Mich. (USA). Hydrocarbons and Energy Research Lab.). 15 Apr 1978. Contract EX-76-C-01-2346. 19p. (DOW/SRPR—26). Dep. NTIS, PC A02/MF A01.

Progress is reported on shale characterization (mostly geochemical), on in-situ fracturing and assessment, and on in-situ extraction trials (combustion). (DLC)

49603 **Method for oil recovery using a horizontal well with indirect heating.** Butler, R.M. (to Exxon Production Research Co.). US Patent 4,085,803. 25 Apr 1978. Filed date 14 Mar 1977. 8p.

Disclosed is a method for recovering hydrocarbons from a subterranean formation. A heated fluid is injected into the formation by means of a perforated conduit which is positioned substantially horizontally through the formation to heat hydrocarbons within the formation. After a suitable heating period, injection of heat is terminated to permit fluids including formation hydrocarbons to drain from the formation into the conduit. The drained fluids within the conduit are then heated to a temperature such that at least a portion of the drained fluids is vaporized. These vaporized fluids pass from the perforated conduit and into the formation to further heat formation hydrocarbons. Subsequently, formation fluids of reduced viscosity are recovered from the formation through the perforated conduit.

49604 **Evaluation of in-situ recovery of tar sands.** Arscott, R.L.; David, A. (Gulf Research and Development Co., Pittsburgh). *In Situ;* **1**: No. 3, 249-266(1977).

Several field tests of in-situ recovery of tar and heavy oil expose the difficulty of achieving an acceptable economic process. The technical problems encountered in achieving successful projects are: adequate communication between wells, mobilization of the tar and maintenance of production wells. If currently available technology for the recovery of tar sand is to compete economically with world prices for other resources, only the highly saturated, thick tar zones can be considered. The Alberta and Venezuelan resources qualify, but much of the U.S. resource is of questionable value.

SURFACE METHODS

REFER ALSO TO CITATION(S) 49748

49605 **Use of control system for gas-solids contacting processes.** Deering, R.F. (to Union Oil Co.). US Patent 4,083,770. 11 Apr 1978. Filed date 30 Aug 1976. 8p.

In gas-solids contacting processes involving the transfer of granular solids from a high-temperature, non-oxidizing treating zone through an enclosed conduit to a combustion zone, the transfer of gases between the treating zone and the combustion zone is prevented by using a novel steam sealing technique which avoids the use of mechanical sealing means and differential pressure controllers. Steam is injected into the system between the two contacting zones, and by the use of flow rate controllers and a pressure controller, a portion of such steam is forced at all times to flow through the combustion zone, while another portion thereof is withdrawn from the transfer conduit in admixture with a portion of net off-gas from the treating zone. The control system is particularly adapted for use in oil shale retorting, wherein coke on the retorted shale is burned in a combustion zone.

49606 **Use of optical activity measurements in oil shale processing.** Lawlor, D.L.; Latham, D.R.; Bartke, T.C.; Asplund, R.O. (Laramie Energy Res Cent, Wyo). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 2, 1-8(1978). (CONF-780305—).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Optical activity measurements of shale oils allow insights into retorting conditions that are not observable by traditional analytical methods. With a bench-scale retort, a low-temperature induction period in the shale before retorting can be observed. The retorting phase itself may be observed by following changes in bitumen and in surface oil optical activity. Optical activity data from Site 9 composite oils, representing 6 months of production, reflect two distinct retorting phases of the experiment. The second, lower optically active phase, may have resulted from secondary degradation of previously accumulated oil. Despite 6 production months, a "steady state" oil was not produced. Optical activity data from 10 different retorting system oils show decreasing optical activity with increasing shale size. 5 refs.

REFINING

REFER ALSO TO CITATION(S) 49379

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 49437, 49600, 49606

49607 **Determination and content of polycyclic aromatic hydrocarbons in bitumen.** Neumann, H.J.; Kaschani, D.T. *Wasser, Luft Betr.;* **21**: No. 12, 648-650(Dec 1977). (In German).

The institut for Petrolium Research in Hanover has been engaged for some ten years on the analysis of bitumens. What is now known on the subject from the works of various authors is reviewed here. One of the points dealt with in the report is that, owing to its content of polycyclic aromatic hydrocarbons, bitumen is not a potential carcinogen. The analysis of the polycyclic aromatic hydrocarbons and their results, aromatic hydrocarbons in bitumen vapours and their solubility in water from bitumens are dealt with.

49608 **Statistical model of the classification of shale in a hydrocyclone.** Lopachenok, L.V.; Punin, A.E.; Belyanin, Yu.I.; Proskuryakov, V.A. *J. Appl. Chem. USSR (Engl. Transl.);* **50**: No. 10, 2227-2229(Oct 1977).

Translated from Zh. Prikl. Khim.; 50: No. 10, 2331-2333(Oct 1977).

The mathematical model obtained by experimental and statistical methods for the classification of shale in a hydrocyclone is adequate for a real industrial-scale process, as indicated by the statistical analysis carried out for it, and together with the material-balance relationships it permits the calculation of the engineering parameters for any classification conditions within the region of the factor space investigated, as well as the search for the optimum conditions for the industrial realization of the process.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 51327

NUCLEAR FUELS

49609 (GJO—100(78)) **Statistical data of the uranium industry.** (Department of Energy, Grand Junction, Colo. (USA). Grand Junction Office). 1 Jan 1978. 111p. Dep. NTIS, PC A06/MF A01.

This document is a compilation of historical facts and figures through 1977. These statistics are based primarily on information provided voluntarily by the uranium exploration, mining, and milling companies. The production, ore reserve, and production capability information has been reported in a manner which avoids disclosure of proprietary information. Due to mining and milling cost increases, references to $10 per pound reserves and potential resources have been deleted, and statistics for $50 per pound have been added for 1/1/78. Also, the size-depth-thickness and the size-grade matrices have been revised to present $50 rather than $30 per pound resources. The graphic distribution of reported future U_3O_8 prices has been replaced by a table of historical and projected average prices for U_3O_8 delivery commitments. The results of a survey of capital investment for uranium production and the history of annual U.S. nuclear plant ordering have been included for the first time. A new section, Production Capability of the Uranium Industry, presents the results of a 1977 GJO assessment of the nation's ability to produce U_3O_8 from the 1/1/77 $30 per pound reserves and probable potential. Appendices give the historical AEC uranium procurement statistics, World Uranium Resources and Production Capability by Continent, a distribution of 1/1/77 $30 reserves and potential by land status, and a diagram of the nuclear fuel cycle.

RESERVES

REFER ALSO TO CITATION(S) 50452

49610 Uranium in 1985: some thoughts on the outlook for resources and supply. Geller, L. (Stoller Corp., New York). *Trans. Am. Nucl. Soc.;* **28**: 314(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49611 Thorium resources and their recovery. McGinley, F.E. (Dept. of Energy, Washington, DC). *Trans. Am. Nucl. Soc.;* **28**: 336-337(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49612 Distribution of thorium, uranium, and potassium in archean granites from northeastern Minnesota. Rye, D.M.; Roy, R.F. (Yale Univ., New Haven). *Am. J. Sci.;* **278**: No. 3, 354-378(Mar 1978).

The investigation of U, Th, and K distributions in 2700 m.y. old granitic rocks from northern Minnesota reveals the typical curvilinear increase in Th and U on Th and U versus K plots observed in most younger calc-alkaline suites.

EXPLORATION

49613 Uranium isotopes in groundwater: their use in prospecting for sandstone-type uranium deposits. Cowart, J.B.; Osmond, J.K. (Florida State Univ., Tallahassee (USA)). pp 365-379 of Geochemical Exploration 1976. Butt, C.R.M.; Wilding, I.G.P. (eds.). Amsterdam; Elsevier (1977).

From 6. international geochemical exploration symposium; Sydney, Australia (Aug 1976).

The relative abundances of dissolved ^{238}U and its daughter ^{234}U appear to be greatly affected as the uranium is transported downdip in sandstone aquifers. In an actively forming uranium accumulation at a reducing barrier, an input of ^{234}U occurs in proximity to the isotopically non-selective precipitation of uranium from the water. The result is a downdip water much lower in uranium concentration but relatively enriched in ^{234}U. The measurement of isotopic as well as concentration changes may increase the effectiveness of hydrogeochemical exploration of uranium. The investigation includes the uranium isotopic patterns in aquifers associated with known uranium orebodies in the Powder River and Shirley Basins, Wyoming, and Karnes County, Texas, USA. In addition, the Carrizo sandstone aquifer of Texas was studied in detail and the presence of an uranium accumulation inferred.

49614 Geochemical exploration 1976. Butt, C.R.M.; Wilding, I.G.P. (eds.). Amsterdam; Elsevier (1977). vp. (CONF-7608120—).

From 6. international geochemical exploration symposium; Sydney, Australia (Aug 1976).

Some individual papers were indexed for inclusion in the data base (LK)

49615 Excess helium-4 in Teggau Lake: possibilities for a uranium ore body. Torgersen, T. (Lamont-Doherty Geological Observatory of Columbia Univ., Palisades, NY); Clarke, W.B. *Science;* **199**: No. 4330, 769-771(17 Feb 1978).

Excess ^4He (more than five times the solubility) has been measured in Teggau Lake in northwestern Ontario. A model suggests that an adjacent mass of greater than 10^4 kilograms of uranium is responsible for the observed ^4He excess. The area is favorable for pegmatitic uranium deposits, and the release of trapped ^4He from uraninite dikes larger than 30 cubic meters (1% U_3O_8) provides the best explanation for the excess ^4He in the lake.

49616 Stream sediment orientation program for Uranium in the Alligator River Province, Northern Territory, Australia. Gingrich, J.E. (Terradex Corporation, Walnut Creek, California (USA)); Foy, M.F. pp 357-364 of Geochemical Exploration 1976. Butt, C.R.M.; Wilding, I.G.P. (eds.). Amsterdam; Elsevier (1977).

From 6. international geochemical exploration symposium; Sydney, Australia (Aug 1976).

Sediments samples were collected from streams draining the Koongarra uranium deposit and the small uranium mines in the South Alligator Valley. Determinations for U, Cu and Pb on various size fractions taken from each of these samples indicated that the best results were obtained for U from the minus 200-mesh fraction, but the train from the Koongarra ore deposit was very short. Cu and Pb were not found to be very useful as indicator elements for U. Alpha-track films were used to determine the Rn content of each sample and the ratio of alpha-track film reading to U content was found to define anomalous drainage areas around the mineralization in the Koongarra area. The areas so defined were of sufficient magnitude to be defined in a reconnaissance stream sediment program.

FEED PROCESSING

REFER ALSO TO CITATION(S) 49611

49617 Fuel fabrication: how will it change. Cupo, J.V. (Westinghouse Nuclear Fuel Div., Pittsburgh). *Trans. Am. Nucl. Soc.;* **28**: 315-316(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

ENRICHMENT

REFER ALSO TO CITATION(S) 49610, 50908, 50909, 50910, 50911

49618 (CONF-780321—, pp 1-8) **Introduction: overview of the U.S. enrichment marketing program.** Saire, D.E. 1978.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

In Conference on enrichment services marketing.

After a brief survey of the issues that will be discussed at the meeting, this paper briefly discusses the areas of status of current DOE enrichment services contracts, factors influencing contract provisions, centrifuge technology and its effect on contract provisions, and DOE marketing objectives (customer relationships). 4 figs. (DLC)

49619 (CONF-780321—, pp 9-14) **Overview of the adjustable fixed-commitment contract.** Ankrum, G.T. 1978.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

In Conference on enrichment services marketing.

This paper discusses a number of key decisions, made by the Administration during the past few weeks, in the area of uranium enrichment contracting. The new AFC contract will afford sufficient contract relief, taking the place of "Open Seasons". (DLC)

49620 (CONF-780321—, pp 15-18) **Conversion from LTFC to AFC contracts.** Dayton, P.D. 1978.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

In Conference on enrichment services marketing.

Contract relief will be offered through conversion to the new Adjustable Fixed Commitment (AFC) contract. The additional advance payments are discussed. Ways of converting the fuel cycle appendices from an LTFC (Long-Term, Fixed Commitment) to an AFC contract are outlined. (DLC)

49621 (CONF-780321—, pp 21-27) **Establishing contract periods.** Huffman, F.C. (Department of Energy, Oak Ridge, TN). 1978.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

In Conference on enrichment services marketing.

The lead time for executing the Adjustable Fixed-Commitment (AFC) contract and exceptions which may be considered are discussed. The initial delivery period is also discussed. Delays, deferrals, and schedule adjustment charges are finally considered. (DLC)

49622 (CONF-780321—, pp 28-37) **Method of establishing firm SWU commitment.** Huffman, F.C. (Department of Energy, Oak Ridge, TN). 1978.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

In Conference on enrichment services marketing.

The procedures used in making the customer's firm separative work requirements are outlined. Information which must be supplied to DOE for firming up the customer's appendices is outlined. The Variable Tails Assay Option (VTAO), available only to AFC customers, is discussed. Planning estimates are needed by DOE to plan the operation of its enrichment complex. The customer notices which are required every year are listed. (DLC)

49623 (CONF-780321—, pp 38-40) **Charges.** McAlduff, H.J. (Department of Energy, Oak Ridge, TN). 1978.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

In Conference on enrichment services marketing.

Enriching services charges are discussed. Invoicing, payment, advance payments, and credits are covered. (DLC)

49624 (CONF-780321—, pp 48-56) **Other enrichment related contracts.** Hall, J.C. (Department of Energy, Oak Ridge, TN). 1978.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

In Conference on enrichment services marketing.

In addition to long-term enrichment contracts, DOE has other types of contracts: (1) short-term, fixed-commitment enrichment contract; (2) emergency sales agreement for enriched uranium; (3) feed material lease agreement; (4) enriched uranium storage agreement; and (5) feed material usage agreement.

49625 **Fulfilling future uranium requirements planning amidst uncertainty.** Worden, J.R.; Bailey, G.F. (Westinghouse Public Power Supply System, Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 308-309(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49626 **Projecting the 1985 fuel cycle: enrichment.** Steyn, J.J. (International Energy Associates Ltd., Washington, DC). *Trans. Am. Nucl. Soc.;* **28**: 314-315(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49627 **Enrichment of ^{235}U by separation nozzle systems with dynamic flow deflection.** Becker, E.W.; Bley, P.; Ehrfeld, U.; Ehrfeld, W.; Knapp, U.; Krieg, G. (Gesellschaft fuer Kernforschung MbH, Karlsruhe, Ger.). *Trans. Am. Nucl. Soc.;* **28**: 371-372(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49628 **HAGA radial-separating-nozzle centrifuge process for uranium enrichment.** Gazda, H.O.E. (HAGA Zentrifugen Gesellschaft m.b.H., Vienna (Austria)). *Atomkernenergie;* **31**: No. 1, 4-5(1978).

Nuclear energy will be the main source of modern energy supply. This brings the enrichment of uranium into the focus of interest. The big advantages of the HAGA process are: low investment cost, low power requirement, low production cost and small number of centrifuges. This process employs under vacuum a kind of internal cascading in the separating element. The centrifugal forces are used for compression and not for separating. The separating effect is brought about by complicated reciprocal action of separating nozzles, formation of vortex, rotation of the gas and shock waves.

49629 **Value function and separative power for asymmetric separation process.** Kanagawa, A.; Yamamoto, I. (Nagoya Univ. (Japan). Faculty of Engineering). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 4, 282-287(Apr 1977).

The separative power of a separating process is represented by the increase of the value of an isotope mixture which passes through the process. The separative power must be independent of the feed concentration, and is expressed by an arbitrary function of the heads and tails separation factors α and β, the functional form being chosen to suit practical convenience. This functional form is used to determine a value function, which is used for calculating the total separative power of an isotope separating cascade. When the constituent elements are asymmetric, different values are obtained for this separative power even if the cascade is operated under the same input and output conditions (i.e. flow rates and concentrations of feed, product and waste). In the present analysis, the functional form of the separative power is so determined as to minimize this dependence on asymmetry. When the feed concentration is very small compared with unity, as in the cases of heavy water production and uranium enrichment, the functional form to be adopted is deltaU=l((α-1)β ln β-(β-1) ln α)/(αβ-1), with which the dependence on asymmetry becomes almost negligible. On the other hand, when the feed concentration is nearly unity, the functional form agrees with that obtained by Bulang et al.: deltaU sub(B) = L((β-1)α ln α-(α-1) ln beta)/(αβ-1).

49630 **Method and appratus for the separation of isotopes.** Dawson, J.M. (to TRW, Inc., Redondo Beach, Calif. (USA)). Australian Patent 76/12,461/A/. 29 Mar 1976. Priority date 29 Aug 1974, United States of America (USA). 49p.

The invention provides a relatively inexpensive method and apparatus for separating isotopes in a substantially neutral, dense plasma, the method being applicable to many elements having more than one isotope. In the method a dense plasma is generated, which includes the isotopes in question, and then injected into a magnetic field where one of the isotopes is given more energy than the others. The selected isotope is separated from the others on the basis of their differential energies. This may, for example, consist of a differential diffusion of the ions across a magnetic field, or magnetic mirrors may be utilized which confine the more energetic species.

CENTRIFUGATION

49631 **Basic characteristics of centrifuges. IV. Analysis of separation performance of centrifuges.** Kai, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 7, 506-518(Jul 1977).

A method of numerically solving the convection-diffusion equation is presented for a binary isotopic gas mixture in the axisymmetric velocity field. A modified Newton's method is employed to perform the numerical integration without the assumptions that the pressure can be estimated from the rigid rotation model and the temperature of gas is uniform. A suitable form of the finite difference equation gives a computationally stable integration with reasonable representation of the molar concentration distribution of isotopic molecules in a rotating cylinder. The method includes a Gaussian elimination procedure which consists of the transformation of the Jacobian matrix to a triangular matrix followed by the backward elimination. Computations are made on UF_6 gas in various centrifuges which have the openings for feed, product and waste on the end plates. Discussions are also presented on gas flows and separative efficiencies for the centrifuges which have baffle plates, skirting plates and bellows.

49632 **Basic characteristics of centrifuges. III. Analysis of fluid flow in centrifuges.** Kai, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 4, 267-281(Apr 1977).

A method of numerically integrating the Navier-Stokes equations is presented for axisymmetric compressible flows. A modified Newton's method is employed to determine the steady motion of gas

in a rotating cylinder without the use of a time-consuming marching process with respect to time. A suitable form of the finite difference equations gives a computationally-stable integration with reasonable representation of the spatial characteristics of the flow. The method includes a Gaussian elimination procedure which consists of the transformation of the Jacobian matrix to a triangular matrix followed by the backward substitution. By using an auxiliary constant matrix algorithm, the method gives the solution within reasonably acceptable computation time. As an example of the method, some features of solutions are presented for the steady flow of UF_6 gas in the centrifuges which have the openings for feed and withdrawal on the end plates.

LASER EXCITATION

49633 High mass isotope separation. Eerkens, J.W. Australian Patent 76/12832/A/. 8 Apr 1976. Priority date 29 Aug 1974, United States of America (USA). 60p.

The method consists of selectively reacting the gaseous uranium hexafluoride molecules in a first physiochemical state and at a higher rovibrational energy state with gaseous hydrogen to provide a chemical compound at a second physicochemical state different from the first state and containing atoms of uranium 235.

49634 Isotope separation process. Lyon, R.K.; Kaldor, A. (to Exxon Research and Engineering Co., Linden, N.J. (USA)). Australian Patent 76/11,713/A/. 5 Mar 1976. Priority date 29 Aug 1974, United States of America (USA). 10p.

The invention relates to a method for isotopically selective excitation of gas phase uranium hexafluoride with a powerful infrared laser followed by selective reaction of the excited uranium hexafluoride with atomic chlorine, bromine or codine to form a product which may be separated by means known in the art.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 50814, 51510

49635 (PB—254737, pp 53-63) **Impact of partitioning on the fuel fabricator.** Knudsen, I.E.; Neuman, B.H. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

The uncertain status of industry activities in the reprocessing and waste management is described. Separate disposal of actinides would cause further delay in the closing of the fuel cycle. The impact of required actinide isolation on the fuel fabricator costs is considered in particular. It is concluded that actinide partitioning is not beneficial to either the fuel fabricator or the needs of the back-end fuel cycle industry. (DLC)

49636 Effect of fabrication variables on fuel performance in LWRs. Strasser, A.; Heckermann, H. (S. M. Stoller Corp., New York). *Trans. Am. Nucl. Soc.;* **28**: 324-325(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49637 Fabrication-related effects on LWR fuel performance. Freshley, M.D.; Brite, D.W. (Battelle Northwest Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 325-326(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49638 Fabrication of metal-clad thorium ceramic recycle fuels. Goldsmith, S.; Brite, D.W. (Battelle Northwest Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 341-342(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49639 Fabrication of UO_2 powder and pellets (IDR process). Heal, T.J.; Littlechild, J.E. (British Nuclear Fuels Ltd., Lancashire, Eng.). *Trans. Am. Nucl. Soc.;* **28**: 326-327(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49640 UO_2 fuel fabrication by means of the AUC powder process. Mathieu, V. (Reaktor-Brennelement Union GmbH, Hanau, Ger.). *Trans. Am. Nucl. Soc.;* **28**: 327-328(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49641 Research reactor fuel fabrication. Moss, T.A. (Atomics International, Canoga Park, CA). *Trans. Am. Nucl. Soc.;* **28**: 368-369(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49642 High-temperature, low-power furnace for processing nuclear fuel. Bowen, W.W. (Westinghouse Hanford Co., Richland, WA); Buckman, R.W. *Trans. Am. Nucl. Soc.;* **28**: 369-370(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49643 Handling system for nuclear fuel pellet inspection. Nyman, D.H. (Westinghouse Hanford Co., Richland, WA); McLemore, D.R.; Sturges, R.H. *Trans. Am. Nucl. Soc.;* **28**: 370-371(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49644 Method to load a weakly acid ion exchanger resin with uranium. Notz, K.J. Jr. (to Energy Research and Development Administration). German(FRG) Patent 2,641,492/A/. 24 Mar 1977. 13p. (In German).

The patent describes a method to load a cation ion exchanger resin with uranyl ions by bringing the resin in touch with an aqueous solution containing the ions. The resin is first converted into the ammonium form and then brought into contact with the aqueous uranyl fluoride solution. The uranyl ions contained in the solution exchange places with the ammonium ions contained in the resin and thus produce the exchanger resin loaded with uranyl ions.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 49638, 49672, 49689, 49693, 49724

49645 (NIIAR-P—18(284)) **Experimental reprocessing of irradiated uranium fuel from BOR-60 reactor by fluoride volatility method.** Kikoin, I.K.; Tsykanov, V.A.; Dem'yanovich, M.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1976. 13p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

The results are described of experiments on fluoride regeneration of irradiated assemblies of the BOR-60 reactor with uranium dioxide, with an average burn-up about 10% and a hold-up time of 3 and 6 months prior to reprocessing. In the course of the experiments, about 4300 g of fuel of the "hot" portion of the assemblies has been regenerated with a 90% initial enrichment with respect to uranium-235, and 4738 g purified uranium hexafluoride obtained, which has been reprocessed into a crystalline dioxide. Using the regenerated fuel and applying the vibrocompaction method, fuel rods have been prepared for re-use in the reactor. The distribution of fission products and the total radioactivity all over the experimental process chain equipment and the regeneration products has been investigated. Data on the yield and purification of uranium, the amount and activity of the process waste are presented.

49646 Projecting the 1985 fuel cycle impact of government actions on the back end of the LWR fuel cycle. Cunningham, G.W. (Dept. of Energy, Washington, DC). *Trans. Am. Nucl. Soc.;* **28**: 318(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49647 Anatomy of a decision: reprocessing technology does not exist and is not approved. Cramer, E.N. (Southern California Edison Co., Rosemead); Brosnan, D.F. *Trans. Am. Nucl. Soc.;* **28**: 321-322(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49648 SRP thorium processing experience. Orth, D.A. (E. I. duPont de Nemours and Co., Aiken, SC). *Trans. Am. Nucl. Soc.;* **28**: 340-341(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49649 Recycle technology for thorium metal fuels. Kittel, J.H.; Bates, J.K. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 342-343(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49650 HTGR fuel recycle technology. Lotts, A.L. (Oak Ridge National Lab., TN); Allen, J.W. *Trans. Am. Nucl. Soc.;* **28**: 343-344(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49651 Analysis of the decommissioning of a nuclear fuel reprocessing plant. Schneider, K.J.; Jenkins, C.E. (Battelle Northwest Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 366-367(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49652 (BNWL-tr—312) **Iodione separation in reprocessing plants.** Wilhelm, J.G.; Furrer, J. 24 Apr 1978. Translation: source information not available. 25p. Dep. NTIS, PC A02/MF A01.

This review deals briefly with the quantities of radioiodine occurring in reprocessing plants and the requirements on separation of iodine from the offgas. The various processes for separation of radioiodine are described, together with their technical development level, and their advantages and disadvantages are discussed. Details are given on separation of iodine from the gas phase by wet scrubbing and collection on solid sorbents. A method for precipitating iodine from the fuel solution is also mentioned. Problems yet to be solved by research and development are discussed. Those include separation of iodine from the vessel offgas, and the stability of the separated products in regard to their storage.

49653 (INEL-tr—25) **Methods development for minimizing waste in the Purex Process.** Schmieder, H.; Goldacker, H.; Finsterwalder, L. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.); Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)). 1977. Translation of German report. 21p. Dep. NTIS, MF A01. Portions of document are illegible.

Developments have made it possible to divide up by far the greatest part of the continually-occurring medium-active process waste into a high-active and a light-active fraction. The former can be added to the existing high-active waste without any essential increase in volume, while the latter fraction, being practically inactive, can be released into the biosphere without additionally burdening it. In addition to the economic advantage, this method also produced an advantage for the end storage as the largest portion of the plutonium waste therewith led to the stable solidification product, glass. The new method omits the Redox medium and the middle-active waste since the small mass flow from the concentration, now economically replaceable, can be added to the high-active waste. An electrolytic mix settler for insertion in the second plutonium cycle of the WAK is currently in test operation. The titanium pulse column corresponds to about a fourth of the throughput of the second plutonium cycle of a 1500 ton per year plant. It will be operated in the still-under-construction plutonium-test stand in the GfK. For the plutonium-uranium separation, a test will be found for a 1 : 1-column in the TEKO. The electrochemical decomposition of nitrates should be tested in the waste handling plant of the GfK in a bypass to the MAW-evaporator. For the electrooxidation of oxalic acid, a test setup in glove boxes is foreseen at the GfK.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 50823, 50824

49654 (SAND—77-1953) **Baseline descriptions for LWR spent fuel storage, handling, and transportation.** Moyer, J.W.; Sonnier, C.S. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 142p. Dep. NTIS, PC A07/MF A01.

Baseline descriptions for the storage, handling, and transportation of reactor spent fuel are provided. The storage modes described include light water reactor (LWR) pools, away-from-reactor basins, dry surface storage, reprocessing-facility interim storage pools, and deep geologic storage. Land and water transportation are also discussed. This work was sponsored by the Department of Energy/Office of Safeguards and Security as part of the Sandia Laboratories Fixed Facility Physical Protection Program. 45 figs, 4 tables.

49655 Methods of criticality analysis for spent-fuel storage facilities. Brown, C.O.; Hansen, L.E. (Exxon Nuclear Co., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 305-307(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49656 Transportation status and problems in the nuclear fuel cycle. Peterson, R.W. (Allied General Nuclear Services, Barnwell, SC). *Trans. Am. Nucl. Soc.;* **28**: 309-311(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49657 Utility perspective on spent-fuel storage. Calabro, R. (Northeast Utilities, Hartford). *Trans. Am. Nucl. Soc.;* **28**: 311-312(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49658 Department of Energy's Spent-Fuel Storage Program. Lawrence, M.J. (Dept. of Energy, Washington, DC). *Trans. Am. Nucl. Soc.;* **28**: 312-313(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49659 Capabilities for processing shipping casks at spent-fuel storage facilities. Baker, W.H.; Arnett, L.M. (E. I. duPont de Nemours and Co., Aiken, SC). *Trans. Am. Nucl. Soc.;* **28**: 330-331(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49660 Design comparisons for away-from-reactor spent-fuel storage basins. King, F.D.; Black, J.E. (E. I. duPont de Nemours and Co., Aiken, SC). *Trans. Am. Nucl. Soc.;* **28**: 331(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49661 Economics of water basin storage of spent LWR fuel. Driggers, F.E. (E. I. duPont de Nemours and Co., Aiken, SC). *Trans. Am. Nucl. Soc.;* **28**: 331-333(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49662 Spent-fuel heatup following loss of water during storage. Benjamin, A.S.; McCloskey, D.J. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **28**: 333-334(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49663 Relative time-integrated spent-fuel storage hazard. Strahl, J.F. (NUS Corp., Rockville, MD); Cramer, E.N. *Trans. Am. Nucl. Soc.;* **28**: 334-335(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 49623, 49624, 49708

49664 (CONF-780321—) **Conference on enrichment services marketing.** (Department of Energy, Washington, D.C. (USA). Div. of Uranium Resources and Enrichment; Department of Energy, Oak

Ridge, Tenn. (USA). Oak Ridge Operations Office). 1978. 120p. Dep. NTIS, PC A06/MF A01.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

Purpose of the meeting was to discuss the draft terms and conditions of DOE's Adjustable Fixed-Commitment (AFC) contract, which was developed to implement the United States nuclear power policy objective of assured nuclear fuel supply on attractive terms and conditions. Nine presentations were made by representatives of both DOE Headquarters and DOE's Oak Ridge Operations Office which co-sponsored the meeting. A question and answer session was held during the afternoon, and these are also presented in this document. Separate abstracts were prepared for eight of the presentations. (DLC)

49665 (CONF-780321—, pp 41-47) **Disposition of excess material.** Hall, J.C. (Department of Energy, Oak Ridge, TN). 1978.

From Conference on enrichment service marketing; Oak Ridge, TN, USA (10 Mar 1978).

In Conference on enrichment services marketing.

This paper reviews briefly the means available to an enrichment customer to dispose of excess material scheduled for delivery under a fixed-commitment contract, other than through termination of the related separative work. The methods are as follows: (1) sales; (2) use in facilities covered by other DOE contracts; and (3) assignment.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 49717

49666 (PB—254737) **Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Material Safety and Safeguards). 1976. 533p. (CONF-760642—; NR-CONF—001). NTIS, PC A23/MF A01.

From Nuclear Regulatory Commission partitioning workshop; Seattle, WA, USA (8 Jun 1976).

Twenty-one papers, with associated discussions, are arranged under four topic headings: values and impacts of waste partitioning, hazards in radioactive waste disposal, alternative methods of waste partitioning, and incentives for waste partitioning. Intervenor statements and discussion summaries are also included. Separate abstracts were prepared for 16 of the papers; the remaining five were previously abstracted. (DLC)

49667 (PB—254737, pp 38-52) **Program to establish the technical feasibility and incentives for partitioning.** Blomeke, J.O. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

ORNL has proposed to ERDA a program for the cost-risk-benefit analysis of actinide partitioning and transmutation as a waste management concept. The program is divided into two groups of tasks: experimental work on separations process flowsheet, and nonpartitioning aspects. These tasks and expected results in FY 1979 are described. (DLC)

49668 (PB—254737, pp 95-106) **Other-than-high-level waste.** Bray, G.R. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

The main emphasis of the work in the area of partitioning transuranic elements from waste has been in the area of high-level liquid waste. But there are "other-than-high-level wastes" generated by the back end of the nuclear fuel cycle that are both large in volume and contaminated with significant quantities of transuranic elements. The combined volume of these other wastes is approximately 50 times that of the solidified high-level waste. These other wastes also contain up to 75% of the transuranic elements associated with waste generated by the back end of the fuel cycle. Therefore, any detailed evaluation of partitioning as a viable waste management option must address both high-level wastes and "other-than-high-level wastes."

49669 (PB—254737, pp 324-359) **Feasibility studies of actinide recycle in LMFBRs as a waste management alternative.** Beaman, S.L.; Aitken, E.A. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

Actinide recycle in LMFBRs offers an attractive alternative on long-term storage of the actinides. The concept will not significantly affect the performance of the LMFBR, but will affect other parts of the nuclear fuel cycle. Assuming that hands-on maintenance will be allowed for Pu-recycle fuel fabrication facilities, the transplutonium actinides should be kept separate from the PuO_2—UO_2 fuel. Thus, the "reference" recycle scheme should be defined as a scheme in which the actinides are recycled in target assemblies. The target assemblies should be reprocessed either in batches separate from spent-fuel batches or in a separate, relatively small, special purpose reprocessing plant. The target assemblies should be fabricated in a special purpose, remotely maintained facility.

49670 (PB—254737, pp 380-395) **Partitioning of nuclear wastes; how why, and when.** Steindler, M.J. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

The present ignorance of safety-related issues of very long-term geologic storage results in the weakening of traditional assurances employed in the licensing of such facilities. Such actions appear likely to endanger the public acceptance of nuclear power. Partitioning and consequent reduction in time scales for storage of wastes can remedy this difficulty to a large extent. It appears reasonable, therefore, to develop the technology of partitioning and to integrate waste management into a single system. There appears to be no urgent, safety-related need to provide for final disposal of wastes very soon after their formation. The NRC position should be: (1) The NRC should not take specific actions at this time related to partitioning except to direct policy toward provisions that maintain ready retrievability of waste containing long-lived components and toward provisions that do not preclude subsequent partitioning of retrieved waste. (2) The NRC should initiate efforts to determine if relaxation of the intense safety posture in nuclear affairs, when applied to long-term waste disposal, will result in unacceptably strong opposition to nuclear power generation. (3) The NRC should encourage the development of scientific information related to geologic disposal and materials behavior to ensure that the reliability of analyses for short-term disposal repositories is adequate to ensure public acceptance.

49671 (PB—254737, pp 417-443) **Beneficial utilization of nuclear waste products, 1976.** Dix, G.P. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

Progress in applications of by-products (fission products, plutonium-238) from the nuclear fuel cycle is reported: noble gases (light sources), sewage sludge processing, food irradiation, power supplies, etc. (DLC)

49672 (RHO-LD—78-3B) **Process technology and process development. Quarterly report, January 1978—March 1978.** (Atomics International Div., Richland, Wash. (USA). Rockwell Hanford Operations). 1978. Contract EY-77-C-06-1030. 161p. Dep. NTIS, PC A08/MF A01.

This quarterly report is the eighth in a series intended to provide information on research and engineering activities being performed to improve the processing of irradiated reactor fuels, the production of plutonium, and the management of resultant chemical wastes.

49673 **Which fuel cycle produces the least alpha-active waste.** Schuman, R.P. (Iowa State Univ., Ames). *Trans. Am. Nucl. Soc.;* **28**: 350-351(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49674 **Time to concentrate on licensing and public acceptability.** Culler, F. *Nucl. Eng. Int.;* **23**: No. 266, 37-40(Jan 1978).

From consideration of a number of factors emerging from the Saltzburg Conference it is suggested that it is now the time to fully demonstrate the technology for waste management and disposal, and to establish the necessary protocols, agreements, and standards to provide control on an international basis. The quantities of waste which will be produced world-wide are estimated and methods of treatment and disposal are summarised. The probable developments in the US programme on waste management and disposal are tentatively stated.

49675 **Radioactive wastes at the Hanford Reservation: a technical review.** Washington, DC; National Academy of Sciences (1978). 284p.

The Hanford military high-level wastes amount to more than 50 million gallons of solids and liquids which have to be immobilized and isolated from the biosphere. Objective of this Panel was to review and evaluate waste management practices and plans at Hanford. Radiation hazards to the public from waste management operations were examined and found to be insignificant, and current monitoring programs are judged to be adequate. The following recommendations and conclusions are made: long-term isolation of high-level wastes should from now be the principal focus of R and D; further chemical separation of the high-level wastes should not be carried out; possibilities for isolation on the Reservation should be studied before offsite transportation is considered; high-level wastes

must be solidified; encapsulation of radioactive Cs and Sr should be halted until capsules have been found for safe long-term disposal; a satisfactory terminal waste repository can probably be developed in the basalt either several hundred meters below the Hanford 200 Areas or in the Rattlesnake Hills; concentrations of radionuclides in liquid effluents to the ground should be no greater than permissible concentrations; and most soils and sediments containing dispersed radionuclides should be left in place, except for the case of Pu. Additional recommendations are made for geologic, hydrologic, and engineering research. (DLC)

WASTE PROCESSING

REFER ALSO TO CITATION(S) 49635, 49652, 49653

49676 (EUR—5635) **Monitoring of plutonium contaminated solid waste streams. Chapter 1: planning of monitoring systems.** Birkhoff, G.; Notea, A. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1977. 80p. Dep. NTIS (US Sales Only), PC A05/MF A01.

The planning of a system for monitoring Pu contaminated solid waste streams, from the nuclear fuel cycle, is considered on the basis of given facility waste management program. The inter relations between the monitoring system and the waste management objectives are stressed. Selection criteria with pertinent data of available waste monitors are given. Example of monitoring systems planning are presented and discussed.

49677 (JAERI-M—7138) **Present status and problems on technology development of high level waste management being in progress at Radioisotope Center, JAERI.** Nakamura, H.; Maeda, S. (eds.). (Japan Atomic Energy Research Inst., Tokyo). Jun 1977. 46p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

Studies and technical developments concerning to the management of the high level waste from the nuclear fuel reprocessing are reviewed. Problems accompanying with the waste management are extracted and then subjects to be studied in future are discussed by cooperation of the study groups of Radioisotope Center, JAERI, which work at studies and technical developments on the waste management. This paper presents the results. First, studies progressing in each group at present were introduced. Then the present status of R and D concerning the disposal of the high level waste in advanced countries was investigated. Finally data and information considered necessary to make schedule of R and D were accumulated. On the base of the information obtained above, aims and subjects of R and D were discussed and following consensus of opinions was attained. The subjects should be taken up from the point of comprehensive and long term view, including the check and review of the nuclear fuel cycle at present. Risk analysis of the ultimate disposal, partitioning and transmutation are particularly important as the subjects to be studied in JAERI.

49678 (NRCN—413) **Process for the bituminization of radioactive wastes.** Bar-Ziv, E.; Manor, D.; Levin, I. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Jun 1977. 84p. (In Hebrew). Dep. NTIS (US Sales Only), PC A05/MF A01.

A process is described for the incorporation of sodium nitrate solutions in bitumen, with a view to the bituminization of radioactive wastes. This process has involved the development of a chemical process and its technological application. A double jacket reactor equipped with an anchor-type stirrer has been built. Sodium nitrate ($NaNO_3$) solutions with sodium hydroxide (NaOH) are fed into the reactor simultaneously with a bitumen emulsion while heated oil is circulated through the double jacket. After all the water has evaporated, the mixture is "simmered" at 170/180°C for up to 5 hours in order to get a homogeneous product which will be suitable for final storage. The product contains small salt crystals (10/50 μm) and has high viscosity (200/2000 poise at 160°C and 12 rpm), so that the possibility of sedimentation is eliminated. In comparative experiments with molten bitumen, large salt aggregates, inhomogeneously distributed, make the product unsuitable. It has been found that NaOH is responsible for the polymerization of the bitumen, which raises its viscosity. The degree of polymerization depends on the NaOH concentration and "simmering" time and temperature. NaOH is added to $NaNO_3$ in order to raise the mixture's viscosity and thereby prevent sedimentation.

49679 (PB—254737, pp 6-23) **Partitioning: an ERDA overview.** Walton, R.D. Jr.; Trice, V.G. Jr.; Dance, K.D. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

This paper provides an historic perspective, a look at the concept of waste management with partitioning, comments on technology status, and information on ERDA's current program. The key questions that must be answered are: can all of the long-lived radionuclides be removed, and what can be done with the bulk of the waste and with the long-lived radionuclides. The last question will probably involve either transmutation or disposal in space. It appears that a fuel cycle industry with partitioning can be put into operation by the year 2000. Since the risk associated with release from geologic terminal storage is so small, the overall safety, technical, and economic implications need to be studied before partitioning is recommended. (DLC)

49680 (PB—254737, pp 24-37) **Partitioning: friend or foe.** Bartlett, J.W. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

Assessment of partitioning will require explicit definition of objectives and comprehensive consideration of the characteristics and impacts of the system that would result from implementation. Complementary analyses to set performance targets for the partitioning operations will also be necessary. Determination of the net benefits of partitioning will depend on who is designated to be the beneficiary. Implementation of partitioning will selectively benefit some and adversely impact others. Decisions and judgments beyond technology and technical analysis will be necessary. Present evaluation tools are not sufficient for the job at hand. Conventional cost-risk-benefit evaluation techniques can handle part of the problem, but techniques to incorporate the social and psychological dimensions and unrecognized but relevant factors are not available.

49681 (PB—254737, pp 81-94) **Potential environmental advantages from partitioning of radioactive wastes.** Russell, J.L. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

Partitioning of radioactive wastes, especially separation of radioactive nuclides with long half-lives, appears to offer a significant reduction in the potential environmental impact of radioactive disposal. Two major considerations are discussed: (1) partitioning must be considered for all wastes and not limited to high-level waste, and (2) separation methods for the longer-lived radionuclides should be emphasized.

49682 (PB—254737, pp 133-151) **Status of reprocessing methods for actinide partitioning.** Leuze, R.E.; Bond, W.D. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

Flowsheets are being prepared that describe processes for removing actinides to very low levels in LWR fuel reprocessing wastes. Partitioning goals are based on decreasing the actinide hazards to that of long-lived fission products. Chemical reagents used in the processing are required not to greatly increase the waste volume. The conceptual processing sequence being investigated for actinide partitioning is based on a combination of modified Purex processing and secondary processing of the high-level waste. Problems involve waste recycle in Purex, adequate U and Np recovery, actinides sorbed on solids and "inextractable" Pu, and adequate Am-Cm removal. (DLC)

49683 (PB—254737, pp 152-207) **Partitioning of long-lived nuclides from radioactive waste: FY 1975 annual report.** Wheelwright, E.J. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

Objectives of this waste partitioning program were to study the incentives for partitioning high-level waste, and to determine the technical feasibility of such partitioning. Six tasks are reported: (1) characterization and treatment of solids in high-level waste (dissolution of Yankee reactor fuel); (2) removal of long-lived nuclides from solidified waste (dissolution of calcine); (3) removal of long-lived nuclides from non-high-level wastes; (4) development of low-additive flowsheets for removing long-lived nuclides from the fission products (integrating a waste partitioning process with Purex process for U, Pu, Np, Am, and Cm removal); (5) evaluation of incentives for partitioning for a waste management system; and (6) comparison of waste management systems with and without partitioning. Recommendations are given for further work. 9 figs., 6 tables. (DLC)

49684 (PB—254737, pp 240-261) **Method of partitioning radionuclides in high-level waste solutions to improve waste management operations.** Cooperstein, R.; Chitwood, R.B. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

Reprocessing of spent fuels result in the production of liquid wastes that require the use of a comprehensive waste management program. There are a variety of processing techniques for managing these wastes. These schemes vary greatly in cost per unit volume of solution processed. A predominant consideration in the use of these approaches is to safeguard adequately the public health and safety. A new processing technique--group separations--is proposed for waste management operations. Group operations of the waste constituents by a homogeneous precipitation technique would optimize radioactive waste solution management. Use of this technique would sim-

plify waste management operations without precluding ultimate management options. Other benefits accruing from this proposal are described.

49685 (PB—254737, pp 262-295) **Separation of actinides from high-level ICPP waste.** Maeck, W.J.; McIsaac, L.D.; Buckham, J.A. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

Options for an updated ICPP waste management plan include actinide removal and terminal storage. The composition of ICPP high-level waste and its hazard are discussed. For the separations of Pu, Am, and Cm, solvent extraction using dibutyl- and dihexyl-N, N-diethylcarbamylmethylenephosphonate in xylene was found promising. Stripping ratios and distribution coefficients were determined. Minimixer settler experiments were conducted. A conceptual actinide removal process is given and discussed. 6 tables, 7 figs. (DLC)

49686 (PB—254737, pp 307-323) **Inorganic ion exchange process for partitioning high-level commercial waste.** Schwoebel, R.L. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

The chemistry of the Sandia Solidification Process, which involves cation exchange with sodium titanate, is discussed. The ion-exchanged material may be hot pressed to obtain a theoretically dense waste form. The chromatographic separation of transuranics, rare earths, and Sr and Cs on a sodium titanate column and its application to partitioning are discussed. (DLC)

49687 (PB—254737, pp 361-379) **Waste management more broadly.** Kubo, A.S. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

The present U.S. high-level waste disposal program focuses on the geologic option. The safety of this option depends heavily on predicting tectonic stability of the selected geologic formation for times that exceed man's total experience. Chemical partitioning and subsequent elimination of the extractants offer one of two currently known methods of foreshortening the duration of concern. The uncertainty of the public response and the history of U.S. high-level waste disposal programs make the option-increasing alternative of chemical partitioning of high-level nuclear wastes an attractive waste management technique. The full range of environmental and operational impacts of applying this technology should be explored now in case at some future time we will find it necessary to use this method.

49688 (UCRL—80064) **Analysis of capital and operating costs associated with high level waste solidification processes.** Heckman, R.A.; Kniazewycz, B.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1978. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

An analysis was performed to evaluate the sensitivity of annual operating costs and capital costs of waste solidification processes to various parameters defined by the requirements of a proposed Federal waste repository. Five process methods and waste forms examined were: salt cake, spray calcine, fluidized bed calcine, borosilicate glass, and supercalcine multibarrier. Differential cost estimates of the annual operating and maintenance costs and the capital costs for the five HLW solidification alternates were developed. (DLC)

49689 **Waste management aspects of alternative thorium fuel cycles.** Blomeke, J.O.; Tedder, D.W. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 344-346(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49690 **Properties of solidified radioactive wastes from commercial LWRs.** Neilson, R.M. Jr.; Colombo, P. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **28**: 349(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49691 **Radiolysis of barium iodate in Portland cement.** Clark, W.E.; Howerton, W.B. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 349-350(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49692 **Plutonium and actinide burnout as a waste management alternative.** Beaman, S.L. (General Electric Co., Sunnyvale, CA). *Trans. Am. Nucl. Soc.;* **28**: 351-352(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49693 **Production facility for solidification of high-level radioactive wastes.** Bingham, G.E.; Wheeler, B.R. (Allied Chemical Corp., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 353-354(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49694 **Recent advances in spray calcination of nuclear waste.** Mikols, W.J.; Romero, L.S.; Bonner, W.F. (Battelle Northwest Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 354-355(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49695 **Actinide lanthanide separation from high-level wastes by oxalate precipitation.** Forsberg, C.W. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 365(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49696 (BNWL-tr—315) **Treatment of radioactive α residue at Mol CEN-SCK (Belgium).** Van de Voorde, N. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). May 1978. Translated from pp 221-236 of (Problable) NEA IAEA Tech Seminar, Paris, 12/1977. 21p. Dep. NTIS, PC A02/MF A01.

At the present time, these wastes—both flammable and nonflammable—are treated by compacting or cutting, then encased in hot asphalt to form a compact homogeneous mass which normally prevents any dispersion of toxic substances. This treatment is carried out in a special work area, designed so that radiotoxic aerosols produced in the treatment process remain confined to that area, which is possible because of a very efficient device which sweeps this area by means of a ventilation system keeping it at lower barometric pressure than the outside, under all circumstances. The staff works in diver suits. However, in view of the range of the problem and the need to establish the strictest standards of residue treatment, a new procedure has been adopted. It simultaneously solves the problems of volume and the final product, which has ideal properties for permanent storage. This procedure, called the complete system, consists of incinerating the residue at a very high temperature (1500°C), most of which is flammable, at the same time as selected nonflammable residue such as glass, metal, sludge, ion exchangers, etc. The incineration residue melts at that temperature, forming an insoluble granitic mass. This process is carried out in a special furnace equipped with a gas purification device and installed in a work area similar to that provided for treatment of α residue, in which the staff must also work in diving suits.

49697 **Processing of radioactive wastes.** Goedkoop, J.A. (Stichting Energieonderzoek Centrum Nederland, Petten). *Energiespectrum;* **2**: No. 2, 50-53(Feb 1978). (In Dutch).

An introductory survey to the phenomenon of natural reactors and in particular the Okelobondo (Gabon) reactor, is given, and its significance with regard to waste processing is discussed.

49698 (LA-tr—78-45) **Solidification of radioactive wastes with inorganic binders (literature survey).** Rudolph, G.; Koester, R. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). 1978. Translation of KFK—2535. 43p. Dep. NTIS, PC A03/MF A01.

A survey is provided on solidification of radioactive waste solutions, sludges and tritium waste water through cement and other inorganic binders. A general survey of the possibilities described in the literature is followed by a somewhat more detailed description of the work carried on at four research establishments in the United States, Oak Ridge National Laboratory, Savannah River Laboratory, Brookhaven National Laboratory, and Atlantic Richfield Hanford Company, supplemented by personal information. Additional sections describe the experiences with various types of cement and the possibilities for improvement of solidification products through preliminary fixation of the toxic nuclides (transformation into insoluble products or absorption); there is a further possibility of post-treatment through polymer impregnation. Finally, definition and determination of leachability are provided and some results compiled. 74 references, 7 figures, 5 tables.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 51035, 51300

49699 (ARH-SA—301) **System design for retrieval of solidified high-level wastes at Hanford.** Wallskog, H.A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 1977. Contract EY-76-C-06-2130. 29p. (CONF-771109—100). Dep. NTIS, PC A03/MF A01.

From ANS winter meeting; San Francisco, CA, USA (27 Nov 1977).

A Waste Retrieval System has been conceptually designed as a step in the process toward the demonstration of the capability to retrieve the projected 36,000,000 gallons of radioactive salt cake and sludge wastes from underground storage tanks at Hanford. This functionally complete, totally remotely operable system consists of a large mobile platform containing all of the tools and equipment necessary to recover, remove and package the wastes for transfer to an onsite processing facility.

49700 (ORNL/TM—6355) **SALTY: a hybrid computer program for three-dimensional heat transfer from a discrete source.** Stone, R.S.; Burke, O.W. (Oak Ridge National Lab., Tenn. (USA)). Jun 1978. 54p. Dep. NTIS, PC A04/MF A01.

SALTY, a hybrid computer code, has been written for calculation of the temperature distributions in an extended medium with spatially varying properties and one or more discrete energy sources. Such complex, multidimensional, time-dependent simulations constitute one useful application of the parallel computation and continuous integration capabilities of the analog-digital hybrid computer. An application of SALTY to a problem involving nuclear waste disposal in salt is described, and the results are compared to those from the pure digital code HEATING5. SALTY gives much the same results at a lower computer cost. Differences in the results are discussed.

49701 (PNL—2651) **Solid phases and solution species of different elements in geologic environments.** Rai, D.; Serne, R.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1978. Contract EY-76-C-06-1830. 140p. Dep. NTIS, PC A07/MF A01.

An investigation was conducted to predict from thermodynamic data the nature of the solid phases and solution species in various weathering environments of different elements (Am, Sb, Ce, Cs, Co, Cm, Eu, I, Np, Pu, Pm, Ra, Ru, Sr, Tc, T, U, and Zr) that are present in radioactive wastes, to predict the degree of adsorption of different elements by the solid matrices and to compare these predictions with observed results, and to determine the influence of different factors (such as Ph, Eh, complexing ligands) on total porewater concentration and the nature of solution species of selected elements. Based on the nature of the predominant solution species, qualitative predictions regarding the adsorption and movement of various elements can be made. Soils and sediments mainly show cation exchange capacities (since these materials carry a large net negative charge) and to a limited extent, anion exchange capacities. Thus, most cations migrate through the soil or rock column at speeds slower than the groundwater. Relative to each other, the trivalent cations generally move the slowest, the divalent cations at intermediate velocities and the monovalent cations most rapidly. Tritium is unique in that it readily substitutes for hydrogen in water and migrates, therefore, at the same velocity as water. The simple anions tend to migrate through soils and rocks with little reaction because usually a pH of less than 4 is required to activate a significant soil anion exchange capacity. The migration and retention of inorganic complex species (mononuclear and polynuclear) would also be dependent upon the charge and size of the species. The behavior of organic complexed species of elements is difficult to predict because of the lack of knowledge regarding the exact nature of the organic ligands, a wide variation in amounts and types of organic ligands, and the size and solubility of these organics.

49702 (SGAE—2650) **Risk of storing radioactive wastes from nuclear power plants.** Gruemm, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Sep 1976. 11p. (In German). (GF-WT—28/76). Dep. NTIS (US Sales Only), PC A02/MF A01.

Serious bottle-necks exist in the nuclear fuel cycle and will continue for the next decade. A total of 800 nuclear reactors are now in operation. 153 nuclear power plants represent an installed capacity of 70 GVe. Until 1985 five hundred nuclear power plants will be in operation from which up to this date 53.000 t uranium will have been discharged. Part of this will have to be reprocessed. Associated with the above mentioned amount are 500 t plutonium and 1.500 t highly radioactive wastes. Two risks for the population have to be considered: firstly, the effect of small amounts of radioactive substances released during normal operation of nuclear power plants (the annual dose is about 1 mrem per person). Secondly, the possibility of the release of great amounts of radioactivity during heavy accidents (the probability for which is extremely small). A series of feasible possibilities for conditioning are shown. Firstly, the wastes are packed in substances which are insoluble in water. Secondly, for low and medium wastes these can be mixed with concrete or bitumen and filled into stable containers. Thirdly, the wastes could also be solidified. Fourthly, the wastes could be enclosed in small glass spheres which are embedded in a metal matrix.

49703 (UCRL—13856) **Third report, development of site suitability and design performance data base for a high level nuclear waste repository.** (Golder Associates, Inc., Kirkland, Wash. (USA)). May 1978. Contract W-7405-ENG-48. 139p. Dep. NTIS, PC A07/MF A01.

This report presents the results of mining and geotechnical studies provided as support for the development of a technical data base suitable for the generation of a regulatory framework governing high-level nuclear waste disposal: flow path models for basalts, salt domes, and crystalline rocks; simplistic model evaluations; loss of administrative control; repository conceptual designs; repository design considerations; and design performance criteria.

49704 (Y/OWI/SUB—77/22335) **Public consultation in public policy information: a state-of-the-art report.** Bishop, A.B.; McKee, M.; Hansen, R.D. (Intermountain Consultants and Planners, Inc., Logan, Utah (USA)). 1977. Contract W-7405-ENG-26. 169p. Dep. NTIS, PC A08/MF A01.

The purpose of the National Waste Terminal Storage (NWTS) Program is to site, construct and operate nuclear waste repositories at several locations. Recent experience indicates that the public is aware of the problems of nuclear waste disposal, and correspondingly there is public concern about how and where to dispose of nuclear wastes. The selection of sites involves a wide range of considerations including geological, technical and environmental feasibility. In addition to these, it is important that societal acceptance of repository options also be taken into account in moving foward with the NWTS Program. Such an incorporation of social considerations and preferences correspondingly implies the need for public consultation in the site selection process. In exploring the concept and state-or-the-art of public involvement in public policy decision, a number of important questions are relevant: (1) What are the basic objectives of public participation in policy formation and program decisions. (2) Who are the "publics" that should be involved and how can they be identified. (3) What information should be communicated between the agency and the publics. (4) What techniques are available to elicit public participation and involvement and what are their capabilities. At the outset, it should be noted that the purpose of this paper in addressing these questions is not to design public participation procedures for the NWTS program. Rather, the above are questions that provide a broad framework for developing an understanding of citizen participation in public policy decisions, such as nuclear waste disposal. In this sense, the following discussion is to provide a context and guidance for approaching the problem of organizing and structuring involvement in the NWTS program. Annotated bibliography of 95 references is included.

49705 (Y/OWI/SUB—4251/3) **Cursory search for carbonates suitable for developing dry underground storage space in the midcontinent, U.S.A.** Byerly, D.W. (Byerly, D.W., Knoxville, Tenn. (USA)). 15 Nov 1975. Contract W-7405-ENG-26. 61p. Dep. NTIS, MF A01.

Portions of document are illegible.

This search for carbonate strata for possible use as nuclear waste repository was prompted by studies of two sites: a deep limestone mine near Barberton, Ohio, and near-surface drift limestone mines near Kansas City, Missouri. Geomorphology, bedrock geology, tectonics and seismicity, and hydrology of the two sites are discussed. It is concluded that the geology of the Barberton site probably offers the greater potential for dry storage over a longer duration of time. Carbonate rocks in North America are evaluated briefly using the criteria just developed, and areas in the midcontinent warranting further study are identified. 26 figures. (DLC)

49706 **Nuclear waste issues and public acceptance.** Nealey, S.A. (Battelle Human Affairs Research Centers, Seattle). *Trans. Am. Nucl. Soc.;* **28**: 322-323(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49707 **Sorption of technetium and iodine radioisotopes by various minerals.** Strickert, R.; Friedman, A.M.; Fried, S. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 365-366(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49708 **Financing the management of uranium mill tailings piles.** Ziskind, R.A.; Hausknecht, D.F. (Science Applications, Inc., Los Angeles, CA). *Trans. Am. Nucl. Soc.;* **28**: 381-383(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49709 Destroying actinides in nuclear reactors. McKay, A. *Nucl. Eng. Int.;* **23**: No. 266, 40-43(Jan 1978).

Incinerating nuclear waste, i.e. selecting out long-lived actinides and re-irradiating them, is still at the early research stage and is a difficult process. The steps involved in the total recycling of the minor actinides are described and the associated problems are discussed.

49710 UK looks at geological and ocean disposal. Feates, F.; Lewis, J. *Nucl. Eng. Int.;* **23**: No. 266, 53-55(Jan 1978).

The UK is developing an initial conceptual design for a final waste repository 500 m deep in hard crystalline rock. Sea bed disposal is also an option. Mathematical calculations are in progress to predict the fate of transuranic isotopes in sediments and also to calculate thermal fluxes.

49711 OECD countries pursue geological disposal. Gera, F.; Oliver, J.P. *Nucl. Eng. Int.;* **23**: No. 266, 35-37(Jan 1978).

Nuclear waste disposal RandD programs are being embarked upon or expanded by 14 OECD countries. The urgent need for an international demonstration program to allay political and public anxieties is emphasized.

49712 Modelling studies used to evaluate waste disposal options. Grimwood, P.; Hill, M.; Webb, G. *Nucl. Eng. Int.;* **23**: No. 266, 55-57(Jan 1978).

Two of the options for disposal of highly active wastes from high water reactors in quantities that would be generated by postulated nuclear power programs by the year 2000 are discussed. They are, disposal in the ocean bed and disposal into geological formations on land. Using simple models, assessments were made of possible transfer of radioactivity to man. The studies mainly identified the areas of work needing further research. Calculated doses were useful as an indication of the order of magnitude of both individual and collected doses which might arises from such disposals.

49713 West Germany gears up for licensing process. Kuhn, K.; Roethemeyer, H.; Salander, C. *Nucl. Eng. Int.;* **23**: No. 266, 48-53(Jan 1978).

West Germany's concept of salt mine waste disposal is discussed with special reference to experience gained at its small reprocessing plant (WAK) in Karlsruhe, and the Asse salt mine near Wolfenbuttel.

49714 Canada keeps its disposal options open. Tomlinson, M. *Nucl. Eng. Int.;* **23**: No. 266, 43-45(Jan 1978).

Various alternatives to water storage have been examined and a development program is in progress to establish a pilot facility for the deep underground disposal of CANDU wastes. The overall program is aimed at developing final disposal capabilities while sustaining various storage and disposal options until the social, economic, health and environmental implications of nuclear power have been adequately resolved.

49715 Swedish utilities design 'completely safe' disposal route. Wivstad, I. *Nucl. Eng. Int.;* **23**: No. 266, 45-48(Jan 1978).

A summary is presented of the main features of the report published by the Swedish nuclear utilities, through their joint KBS (Nuclear Fuel Safety) project, on the disposal of highly active waste from reprocessing. Brief descriptions are given of the intermediate storage facility, and the geological conditions and facility for ultimate storage. Safety aspects are discussed. Various steps under examination for a process of direct disposal are outlined.

49716 Purpose and licensing status of the ASSE test storage facility. Breest, H.C. (Bundesministerium des Innern, Bonn (Germany, F.R.). Abt. Sicherheit Kerntechnischer Anlagen); Pfaffelhuber, J. (Bundesministerium des Innern, Bonn (Germany, F.R.). Referat Entsorgung und Versorgung von Kerntechnischen Anlagen). *Atomwirtsch., Atomtech.;* **22**: No. 12, 641-642(Dec 1977). (In German).

Since its acquisition in 1965, the former salt mine ASSE II has been converted by the GSF into a test facility for the development, testing and optimization of methods for storage and ultimate storage of radioactive waste. As the mine had not been constructed for this purpose, the type and amounts of waste were strictly limited. However, except for high-activity waste, which can be taken out again, it was clear from the beginning that the waste should remain in the ASSE mine when the tests had been successfully completed. After the acts amending the Nuclear Energy Act and the Radiation Protection Ordinance, a license according to article 3, paragraph 1 of the new Radiation Protection Ordinance will be necessary to carry on with the R+D program at the ASSE mine; a plan approval procedure according to article 9b of the Nuclear Energy Act is not necessary.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 49681, 49701

49717 (PB—254737, pp 107-131) Environmental hazards from high-level waste. Cohen, B.L. 1976.

In Proceedings of the conference on the management of radioactive waste: waste partitioning as an alternative.

This paper presents methods for quantifying the hazards from high-level waste to put them into perspective with other hazards we experience and draws conclusions on the value of partitioning the waste and of maintaining surveillance on a waste repository.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 49663, 49712, 51252

49718 (SGAE—2709) Estimation of risk due to accidents for the transport of radioactive wastes to the conditioning and storage facilities in the Research Center of Seibersdorf. Krejsa, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Feb 1977. 26p. (In German). (ST—65/77). Dep. NTIS (US Sales Only), PC A03/MF A01.

By the use of an American statistic of accidents on roads the risk of body burden is estimated resulting from the transport of radioactive wastes to the central collection, conditioning and storage facilities in Seibersdorf. It is shown that the risk of the transport from power stations up to 1990 is below that of other producers of radioactive wastes (hospitals, industry and research laboratories). The risk of the individual body burden is estimated to be in 1976: $1.1 \cdot 10^{-10}$ mrem/a; 1978: $2.8 \cdot 10^{-10}$ mrem/a; 1985: $3.0 \cdot 10^{-10}$ mrem/a; 1995: $3.3 \cdot 10^{-10}$ mrem/a. These results are so much below the natural radiation in the environment, that they cannot be seen as an increase in the given potential hazard.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 50746

49719 (HEDL-TME—78-40) Evaluation of shipper/receiver differences involving shipments of plutonium dioxide. Delvin, W.L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1978. Contract EY-76-C-14-2170. 27p. Dep. NTIS, PC A03/MF A01.

This report discusses conditions and analytical measurement data relating to significant shipper/receiver differences involving shipments of low-fired plutonium dioxide. It presents findings that point to water adsorption as the cause of these differences and recommends a plan to reduce them significantly.

49720 (SAND—78-0730) Physical protection of nuclear facilities. Quarterly progress report, October—December 1977. Chapman, L.D. (ed.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Jun 1978. Contract EY-76-C-04-0789. 28p. (NUREG/CR—0146). Dep. NTIS, PC A03/MF A01.

Activities included the construction of refueling fault trees for nuclear power reactor operation, the development of procedures for the systematic construction of generic fault trees for LWRs, and the demonstration of a technique for using measures or weights to rank-order the sets of vital areas identified in Vital Location Analysis. Assistance was provided to LASL in its application of generic fault tree and Vital Location Analysis techniques to the identification of vital areas in power reactors. The optimal graph (facility) investment computer program was successfully compiled and executed on the NOS time-sharing system. The safeguards data base development programs were consolidated and an extensive examination of the GSA scheduled data management software was initiated. Work also began on applying utility theory to the Fixed-Site Neutralization (FSN) model and a completeness statement for safeguards effectiveness evaluation methodologies was composed. Work continued on the development of fault trees for an example reprocessing facility and the development of an improved approach to reduction of large fault trees. Improvements have been made to the subroutine MINDPT, as well as to the four Dijkstra shortest-path subroutines and the Approximate Shortest Paths (ASP) subroutines. A new implementation of the Estimate of Adversary Sequence Interruption

(EASI) and a new more easily applied interactive version of the Forcible Entry Safeguards Effectiveness Model (FESEM) have been developed. In addition, a time-saving set of modified Safeguards Automated Facility Evaluation (SAFE) programs which utilizes variables in place of facility-specific values has been created.

49721 (SAND—78-1017) **Design of integrated safeguards systems for nuclear facilities.** de Montmollin, J.M.; Walton, R.B. (Sandia Labs., Albuquerque, N.Mex. (USA); Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1978. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

Safeguards systems that are capable of countering postulated threats to nuclear facilities must be closely integrated with plant layout and processes if they are to be effective and if potentially-severe impacts on plant operations are to be averted. This paper describes a facilities safeguards system suitable for production plant, in which the traditional elements of physical protection and periodic material-balance accounting are extended and augmented to provide close control of material flows. Discrete material items are subjected to direct, overriding physical control where appropriate. Materials in closely-coupled process streams are protected by on-line NDA and weight measurements, with rapid computation of material balances to provide immediate indication of large-scale diversion. The system provides information and actions at the safeguards/operations interface.

49722 (SAND—78-1242C) **Electronic self-monitoring seal.** Campbell, J.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 7p. (CONF-780606—6). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

The Electronic Self-Monitoring Seal is a new type of security seal which allows continuous verification of the seal's identity and status. The identity information is a function of the individual seal, time, and seal integrity. A description of this seal and its characteristics are presented. Also described are the use cycle for the seal and the support equipment for programming and verifying the seal.

49723 **Nonproliferation criteria for nuclear fuel cycles.** Laney, R.V.; Huebotter, P.R. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 320(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49724 **Dynamic process model of a plutonium oxalate precipitator.** Borgonovi, G.M. (Science Applications, Inc., La Jolla, CA); Hammelman, J.E.; Miller, C.L. *Trans. Am. Nucl. Soc.;* **28**: 374-375(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49725 **Preirradiation of LMFBR fresh fuel assemblies to improve proliferation resistance.** Talwar, B.; Deane, N.A.; Bailey, H.S. (General Electric Co., Sunnyvale, CA). *Trans. Am. Nucl. Soc.;* **28**: 375(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49726 **Evaluation and vulnerability analysis of portal monitors.** Gozani, T. (Science Applications, Inc., Palo Alto, CA). *Trans. Am. Nucl. Soc.;* **28**: 376-377(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49727 **International nonproliferation issues.** Boright, J.P. (Dept. of State, Washington, DC). *Trans. Am. Nucl. Soc.;* **28**: 320-321(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

FUSION FUELS

PROCESSING

49728 **Plating discrete microparticles for laser-fusion targets.** Mayer, A.; Catlett, D.S. *Plat. Surf. Finish.;* **65**: No. 3, 42-46(Mar 1978).

Plating techniques and apparatus have been developed for depositing metallic coatings on discrete, hollow microspheres 50 to 500 mum in diameter, used as fuel containment vessels in inertial confinement fusion research. The deposition of both electroless and electrolytic coatings is described, and some of the plating results are discussed. 11 refs.

REPROCESSING

49729 (UCRL—52455) **Extraction of tritium from liquid lithium by permeation.** Alire, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Apr 1978. Contract W-7405-ENG-48. 8p. Dep. NTIS, PC A02/MF A01.

This paper assesses a method for extracting tritium from liquid lithium for specific application to the conceptual laser fusion reactor that uses a continuous lithium "waterfall." The tritium diffuses through a refractory metal that contains a getter and is then stored in a hydride-forming alloy. There are various uncertainties with this method including helium-4 extraction, unknown impurities that may accumulate in liquid lithium, the effects of these impurities on tritium separation, and the maintenance of tritium-contaminated equipment. Our study indicates that major tritium losses will occur during equipment maintenance rather than as a result of permeation losses through the primary vessel.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 51631

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 51631

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

REFER ALSO TO CITATION(S) 49671

PHYSICAL ISOTOPE SEPARATION

49730 **Heterogeneous condensation of BCl_3 in the presence of CO_2 laser irradiation.** Anderson, G.K.; Lee, J.T. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Opt. Lett.;* **3**: No. 1, 10-12(Jul 1978).

Isotope-enrichment experiments were conducted in an attempt to measure the effect of laser excitation on the heterogeneous sticking coefficient of BCl_3. Our results indicate that the effect, if any, is very small. This is in contrast to the work of Gochelashvili et al. [Sov. Phys. JETP 43, 274—277 (1976)], who reported an enrichment ratio of $\alpha=1.57$ under very similar experimental conditions.

49731 **Measurements of velocity profiles of gas in a rotating cylinder.** Tokoi, H.; Ozaki, N.; Harada, I. (Atomic Energy Research Lab., Kawasaki, Japan). *Trans. Am. Nucl. Soc.;* **28**: 373(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

49732 **Aerodynamic effects in isotope separation by gaseous diffusion.** Bert, L.A. (Universita di Milano, Italy); Prosperetti, A.; Fiocchi, R. *Int. J. Heat Mass Transfer;* **21**: No. 5, 639-645(May 1978).

The turbulent flow of an isotopic mixture in a porous-walled pipe is considered in the presence of suction through the wall. A simple model is formulated for the evaluation of aerodynamic effects on the separation efficiency. The predictions of the model are found to compare very favorably with experiment. In the limit of small suction velocities results obtained by other investigators for diffusion in a turbulent stream are recovered.

HEAVY WATER PRODUCTION

REFER ALSO TO CITATION(S) 49629, 50773, 50776

49733 (UCID—17736-78-1) **Development of advanced concepts for improved heavy water production technology.** Aldridge, F.T.; Herman, I.P.; Marling, J.B.; Wood, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1978. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

Three significantly different advanced heavy water production technology processes continued under active investigation during the reporting period. Two optimum reagents have been selected for the process based on infrared laser multiphoton dissociation of organic molecules. A preliminary chemical engineering evaluation of this process indicates relatively high gas pumping costs in a process operating at low pressures (e.g., 10 to 100 torr). The required lasers and gas chromatograph are now operational to support evaluation of the process based on gas-phase deuterium halide addition into olefins. The $CaNi_5$ alloy for chromatographic separation of hydrogen isotopes continued under active investigation, based on its attractive economic and physical properties, combined with high deuterium separation factors.

49734 **Selecting heavy water processes.** Rae, H.K. (Chalk River Nuclear Labs., Ont.). pp 1-26 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

The GS process is the only large-scale independent process with a direct water feed and this is largely responsible for its pre-eminent position in heavy water production. Water-hydrogen exchange is only attractive in combination with electrolytic hydrogen production—the combined electrolysis and catalytic exchange (CECE) process. Three hydrogen-based processes, amine-hydrogen, ammonia-hydrogen and hydrogen distillation, are all close to being competitive with the GS process. Of these, amine-hydrogen is likely to be the cheapest. Hydrogen distillation linked to natural gas as the deuterium source, while distinctly energy intensive, may be a near competitor under some circumstances. Hydrogen is a potentially abundant heavy water source, but individual plants are small. However, hydrogen-based heavy water plants are being built and more will be committed. Nonetheless, the GS process will continue as the dominant one for another 10 or 20 years. (15 figs, 6 tables, 23 refs).

49735 **Bruce heavy water plant performance.** Davidson, G.D. (Bruce Heavy Water Plant, Triverton, Ont.). pp 27-39 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

The plant has a design capacity of 96.6 kg/h of 99.75% D_2O. It uses the Dual Temperature H_2S—H_2O exchange process. The performance of the "A" plant is described in terms of: employee safety, care of environment, reliability, and manpower development. Commissioning progress to date on the "B" plant is described.

49736 **Hydrogen—amine process for heavy water production.** Holtslander, W.J. (Chalk River Nuclear Labs., Ont.); Lockerby, W.E. pp 40-52 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

The hydrogen-amine process for heavy water production employs a deuterium isotope exchange reaction between hydrogen and methylamine containing a dissolved alkali metal methylamide catalyst. This system is chemically very reactive and a detailed understanding of all aspects of the process chemistry was required. This understanding was made more difficult by the lack of information in the literature on this or similar systems. The majority of the work was of a pioneering nature. For example, a hitherto unknown side reaction of hydrogen at process pressure with the original exchange catalyst was discovered. The successful development of a new catalyst restored the viability of the process so that commercial application is now feasible and is being pursued. 7 figures.

49737 **AECL—Sulzer amine process for heavy water.** Wynn, N.P. (Sulzer Brothers Ltd., Pointe Claire, Quebec). pp 53-70 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

A heavy water process based on isotopic exchange between hydrogen and methylamine and methylamine and water has been developed by Sulzer and Atomic Energy of Canada. Deuterium source is the synthesis gas stream of an ammonia plant. Deuterium enrichment is achieved by bithermal amine-hydrogen exchange; however, preliminary enrichment is made to occur in the reformers of the ammonia plant by using the steam reforming process as the decomposition step of a monothermal enrichment stage. This feature, coupled with the high value of the separation factor achievable with hydrogen-amine exchange, allows a high deuterium yield without the use of hydrogen recycle in the extraction stage. Design work has been based on pilot tests of the key process steps using industrial contacting equipment. 8 figures.

49738 **Heavy water production by isotopic exchange between hydrogen and methylamine.** Briec, M. (CEN, Saclay, France); Ravoire, J.; Rostaing, M.; Roth, E.; Lefrancois, B. pp 71-76 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

The exchange rates in the H_2-MMA system are extremely fast in view of the activity of the catalyst and the solubility of hydrogen. The development of a sufficiently stable and soluble catalyst means that the construction of heavy water plants is feasible under financially competitive conditions. The production of appreciable quantities of heavy water from the hydrogen used for synthesis of ammonia is now possible in many countries. If the use of hydrogen in the future as an energy vector is developed, the MMA-hydrogen process will profit from the scale effect in the building of units, and the low prices of thermal and electrical supplies available at the proximity of hydrogen chemical-nuclear generators.

49739 **UHDE process for the recovery of heavy water from synthesis gas.** Nitschke, E.; Ilgner, H.; Walter, S. (Friedrich Uhde GmbH, Dortmund, Ger.). pp 77-92 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

A heavy water plant with a capacity of 63 tons D_2O per year will be built at Talcher/India. The plant is coupled with a 900 t per day ammonia plant and will be put on stream beginning 1978. A comparison of the production costs based on the calculation for this plant shows with regard to the investment as well as to the operating costs that this process can compete with other processes or may even be superior.

49740 **Heavy water distillation.** Keyser, G.M.; McConnell, D.B.; Anyas-Weiss, N.; Kirkby, P. (Ontario Hydro Research Div., Toronto). pp 126-133 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

A review of distillation as a heavy water separation method has identified areas of high cost: energy and packing material. At temperatures around 25°C, large amounts of energy are available as waste heat from thermal generating stations. If a suitable low-cost packing can be developed for use in this temperature region, distillation could become economically competitive. Results of theoretical packing work, and experiments on a prototype packing for heavy water plants are discussed.

49741 **Operating experience with the tritium and hydrogen extraction plant at the Laue-Langevin Institute.** Pautrot, P. (Inst. Max Von Laue-Paul Langevin, Grenoble, France); Damiani, M. pp 163-170 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

The plant extracts H and D simultaneously from heavy water, using catalytic exchange between D_2O vapor and D_2 gas at 200°C and 1.2 bar, and low-temperature rectification of the hydrogen isotopes at 1.5 bar. The principle of operation, plant safety precautions, startup of plant and operating experience, and difficulties encountered during operation are discussed. (DLC)

RADIATION SOURCES

REFER ALSO TO CITATION(S) 51512

HYDROGEN

PRODUCTION

49742 State and chances of hydrogen technology. Knoche, K.F. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Technische Thermodynamik und Inst. fuer Thermodynamik). *VGB Kraftwerkstech.;* **58**: No. 2, 90-94(Feb 1978). (In German).

According to today's state of technology, one can already produce hydrogen without using fossil fuels by means of high-temperature nuclear reactors with attached electrolysis; however, the overall efficiencies and production costs exclude a large-scale production on an long-term basis. Efficiency improvement of the conventional electrolysis method is being worked upon, one needs 5 to 10 years time for its development. The high temperature electrolysis operating already in laboratories with efficiencies of 100% and over, requiring more than double the electricity than for common electrolysis, should be of interest for future gas supply. Thermochemical and hybrid methods basically have a development potential comparative to high-temperature electrolysis; however, there is get a lot of development work to be done before it can be realized.

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 50763

49743 (GA-A—14950) **Thermochemical water-splitting cycle, bench scale investigations and process engineering. Annual report, February—December 31, 1977.** Caprioglio, G.; de Graaf, J.D.; McCorkle, K.H.; Norman, J.H.; Ohno, T.; Russell, J.L.; Webb, G.C. (General Atomic Co., San Diego, Calif. (USA)). Apr 1978. Contract EY-76-C-03-0167-063. 92p. Dep. NTIS, PC A05/MF A01.

This document is an annual progress report of DOE-sponsored process development work on the General Atomic sulfur-iodine thermochemical water-splitting cycle. The work consists of laboratory bench-scale investigations and process engineering design studies. A bench scale system, consisting of three subunits, has been planned to study the cycle under continuous flow conditions. The design of subunit I, which models the main solution reaction and product separation, and subunit II, which models the concentration and decomposition of sulfuric acid, is presented and discussed. Progress on the construction and operation of subunit I is described. The process engineering addresses the flowsheet design of a large-scale production process consisting of four chemical sections (I through IV) and one helium heat supply section (V). The completed designs for sections I (main solution reaction) and II (sulfuric acid-water separation and sulfuric acid decomposition) are given along with a partial design for section IV (hydrogen iodide decomposition and hydrogen recovery), which is not yet complete. The appendix contains a description of the process simulator computer code that is being used to aid the process design.

STEAM REFORMER PROCESSES

REFER ALSO TO CITATION(S) 49752

49744 Process for the production of hydrogen from natural gas and oil fractions. Juentgen, H.; Reichenberger, J. *Brennst.-Waerme-Kraft;* **30**: No. 2, 53-58(Feb 1978). (In German).

The catalytic reforming of methane and the low-boiling petroleum fraction by steam in cracking pipes, heated from outside, is being carried out technically since the end of the 1930's. From mid 1950's on, the partial oxidation of heavy petroleum residues for hydrogen production was introduced on a technical scale. The article describes the process routes and the technical realisation, for both processes including desulphurisation of the feedstocks and gas conditioning. A comparison shows, that the quality of technical development for both processes is equal, but that they differ on economical aspects. As in the case of the partial oxidation process the investment costs are much higher compared with the steam reformig process, the former can only be applied economically, if a certain price differential between low-boiling petroleum fractions and heavy petroleum residues is exceeded. Finally, the possibilities are described of using heat from high-temperature reactors for hydrogen production from hydrocarbon feedstocks.

PARTIAL OXIDATION PROCESSES

REFER ALSO TO CITATION(S) 49744, 49748

STORAGE

CHEMISORPTION

49745 Hydrogen storage electrodes and hydrogen transfer cells. Lewis, F.A. (Queen's Univ., Belfast); Obermann, A.; Bucur, R.V.; Bell, J.N.A.; Leitch, W.F.N. pp 259-268 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The role of metals and intermetallic compounds capable of rapidly absorbing and desorbing hydrogen seems likely to become increasingly important in regard to the storage of hydrogen produced by electrolysis and its subsequent use in electrochemical cells. Some features of possible hydrogen storage electrodes are discussed with reference to experimental problems and to recent information in related areas of study.

OTHER SYNTHETIC AND NATURAL FUELS

HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 50653

PROPERTIES

REFER ALSO TO CITATION(S) 50760

49746 Universal formula for the electrical conductivity of the combustion-products plasma of hydrocarbon fuels. Atrazhaev, V.M.; Zelener, B.V.; Yakubov, I.T. (Institute of High Temperatures, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **22**: No. 12, 760-762(Dec 1977).

Starting from the Lorentz and Saha equations, a formula is derived for the electric conductivity and Hall coefficient of combustion products as functions of hydrocarbon ratio, oxygen enrichment, temperature, pressure, and fraction of alkali addition.(AIP)

PREPARATION

CHEMICAL SYNTHESIS

49747 Biomethanation: anaerobic fermentation of CO_2, H_2, and CO to methane. Wise, D.L.; Cooney, C.L.; Augenstein, D.C. (Dynatech R/D Co., Cambridge, MA). *Biotechnol. Bioeng.;* **20**: No. 8, 1153-1172(Aug 1978).

Studies to examine the microbial fermentation of coal gasification products (CO_2, H2 and CO) to methane have been done with a mixed culture of anaerobic bacteria selected from an anaerobic sewage digestor. The specific rate of methane production at 37°C reached 25 mmol/g cell hr. The stoichiometry for methane production was 4 mmol H_2/mol CO_2. Cell recycle was used to increase the cell concentration from 2.5 to 8.3 g/liter; the volumetric rate of methane production ran from 1.3 to 4 liter/liter hr. The biogasification was also examined at elevated pressure (450 psi) and temperature to facilitate interfacing with a coal gasifier. At 60°C, the specific rate of methane production reached 50 mmol/g cell hr. Carbon monoxide utilization by the mixed culture of anaerobes and by a Rhodopseudomonas species was examined. Both cultures are able to carry out the shift conversion of CO and water to CO_2 and hydrogen.

49748 Process for the production of pipeline gas, pure hydrogen and other products from hydrocarbon raw materials. Moody, B.E.; Schuster, J.E. (to Air Products and Chemicals, Inc., Allentown, Pa. (USA)). German(FRG) Patent 2,639,186/A/. 31 Mar 1977. 40p. (In German).

In order to compensate for the natural gas shortage, a method is suggested to produce synthetic gas starting from heavy products such as gas oils, bitumen or even liquefied coal products. The method does not work catalytically. The vaporizable part of the initial material is introduced with excess hydrogen into an adiabatically operated reactor and converted at temperatures over 800°C. A gas is produced mainly consisting of methane, hydrogen, hydrogen sulfide and a vapor mainly consisting of benzene and which after condensation is recycled into the reactor. The gas is freed of acid components and can then be processed in low-temperature decom-

position into methane and hydrogen; hydrogen is then recycled into the reactor. The gas can alternatively be converted to CO/H_2 in a catalytic steam reformation process and further converted to hydrogen. The non-evaporable components of the initial material are gasified with oxygen in a common Texaco gasification plant in order to produce the initial hydrogen for the actual process. This step requires an air seperation plant.

49749 Process for synthesizing methane. Kiovsky, T.E.; Wald, M.M. (to Shell Internationale Research Maatschappij N.V., The Hague (Netherlands)). German(FRG) Patent 2,603,892/A/. 5 Aug 1976. 32p. (In German).

A method is described to produce methane using a gas mixture of H_2, CO and/or CO_2 as starting material. The gas mixture is brought into contact with a molten liquid catalyst at temperatures above 500°C. The catalyst consists of melted on alkalimetal and/or alkaline earth metal halides or carbonates and/or halides of Zn, Cu, Mn, Cd, Sn and Fe as carrier material. The melting point of the salts or salt mixtures is below 1000°C. The metals Fe, Mo, Mn, Ni, Co, Zn, Ti, Ag, Cu and/or Th or their oxides and/or carbides are finely dispersed as active components.

49750 Procedure for the synthesis of fuel gas with a calorific value of at least 9.500 kcal/Nm³. Yamaguchi, K.; Nishinomiya, H.; Iguchi, S. (to Osaka Gas Co. Ltd. (Japan)). German(FRG) Patent 2,226,086/C/. 16 Jun 1976. 7p. (In German).

The invention describes a method to produce fuel gas whose main components are methane and ethane with a calorific value fo at least 9,500 kcal/Nm³. As initial mixture, a hydrocarbon with a least 3 carbon atoms and a boiling point not higher than 150°C is mixed with hydrogen in the gaseous phase in the presence of a catalyst at a temperature between 150 and 400°C. The catalyst contains molybdenum oxide arranged on a solid carrier to a quantity of 10 to 70 wt.% and at least one of the following oxides namely: nickel oxide, cobalt oxide, chromium oxide, to a share of 3 to 15 wt.%, and the atomic ratio of the hydrogen to carbon in the initial mixture is between 3.5:1 and 4:1.

49751 Process for reforming hydrocarbons. White, G.A.; Roszkowski, T.R.; Fleming, H.W. (to Parsons (Ralph M.) Co., Pasadena, Calif. (USA)). German(FRG) Patent 2,552,153/A/. 26 May 1976. 17p. (In German).

In the described method to reform hydrocarbons by the catalytic conversion of a gas flow of hydrocarbon and steam on a reforming carrier catalyst at about 482 to 871°C, the gas flow contains more steam than is stoichiometrically required for reformation. At least one part of the excess steam in the gas flow necessary to prevent the formation of carbon is replaced by at least 1 ppm H_2S. During reformation, H_2 and/or CO as hydrogen source are at least used in a quantity stoichiometrically sufficient for the conversion of the total carbon in the hydrocarbon to methane.

49752 Preparation of methane, hydrogen and carbon monoxide containing gases. Dorawala, T.G.; Estes, J.H.; Kerr, E.R. (to Texaco Inc.). US Patent 3,957,682. 18 May 1976. vp.

Texaco Inc.'s new rugged catalyst offers improved catalyst life while gasifying, with steam, nonaromatic hydrocarbons boiling up to 600°F (such as naphtha) to produce methane-containing gases. The activated catalyst consists essentially of a massive metal screen containing at least 50 to 75 percent nickel. The preferred metal may be a nickel-chromium alloy such as Inconel 600. The hydrocarbon-steam mixture (having a steam/hydrocarbon mole ratio of 5 to 20:1) is maintained at 700 to 1100°F and 300 to 800 psig.

49753 Process for producing a methane-containing gas and arrangement therefor. Goeke, E.; Staege, H. (to Krupp-Koppers GmbH). US Patent 3,954,424. 4 May 1976. vp.

In a new approach developed by West Germany's Krupp-Koppers GmbH, methane-containing gas (80 vol. percent methane) is produced by a more economical process that subjects a desulfurized gaseous mixture produced from partial oxidation of coal and/or heavy oil to a simultaneous conversion and methanization reaction at 660 to 750°F (350 to 400°C) and 3 to 60 atm. The two reactions occur in a common reactor containing standard conversion and methanation catalysts arranged in one fixed bed.

49754 Method for the conversion of hydrocarbon contained materials. Sze, M.C.; Bennett, T.M.; Unger, H. (to Lummus Co., Bloomfield, N.J. (USA)). German(FRG) Patent 2,545,296/A/. 22 Apr 1976. 21p. (In German).

A method is described for the conversion of hydrocarbon-contained materials containing pyrolysis fuel oils in equal charge supplies of essentially constant quality. The materials are subjected to the following process stages prior to being used for the production of coke or soot: sulphur is added to the materials containing pyrolysis fuel oil, the materials are held at over 232°C for at least 5 minutes in the softener drum, the materials were heated to a temperature between 454°C and 593°C for a duration of 8 to 110 seconds at an outlet pressure of 24.5 to 42 atmospheres above atmospheric pressure.

49755 Catalyst and its use for the manufacture of methane from gases containing carbon monoxide and dioxide and hydrogen. Broecker, F.J.; Zirker, G.; Triebskorn, B.; Marosi, L.; Schwarzmann, M.; Dethlefsen, W.; Kaempfer, K. (to BASF AG). US Patent 3,912,775. 14 Oct 1975. vp.

An improved nickel catalyst from West Germany's BASF AG allows the production of methane from carbon monoxide, carbon dioxide, and hydrogen at a lower feedstock temperature of only 392° to 572°F (200° to 300°C). The catalyst is manufactured by precipitating the compound $Ni_6Al_2(OH)_{16}CO_3 \times 4H_2O$ from aqueous solution, drying it at a temperature of 176° to 356°F (80° to 180°C), calcining it at a temperature of 572° to 1022°F (300° to 550°C), and subsequently reducing it in a stream of hydrogen. Between the drying stage and the calcination stage, the temperature is raised at a rate of 3° to 6°F (1.66° to 3.33°C)/min.

49756 Procedure for generating a gas enriched with methane. Child, E.T.; Taylor, A.M. (to Texaco Development Corp., New York (USA)). German(FRG) Patent 2,420,555/A/. 16 Jan 1975. 28p. (In German).

A continuous method to produce a gas containing at least 90 mol% methane (dry) is described. A hydrocarbon starting material is subjected to a partial oxidation with air or oxygen-enriched air containing 50-79 mol% n_2 and, if desired, to a temperature moderator. The partial oxidation reaction occurs in a non-catalyst, fire-proof covered synthesis gas generator free from flow obstacles at an autogenic temperature of about 816 to 1927°C and at about 1-350 atm. The outflow of the generator consists of CO, H_2, CO_2, H_2O and small amounts of CH_4, Ar, H_2S, C particles and about 30-60 mol% N_2. The crude process gas is then cooled, cleaned and purified, N_2 as diluting agent due to exothermic, strong reaction. In a first methanation step, all H_2 of the process gas is reacted with CO to CH_4, additional water is then introduced, the process gas is converted in a water gas reaction in order to produce sufficient H_2. The remaining CO can be converted in a second methanation reaction.

PREPARATION FROM WASTES OR BIOMASS

49757 Energy and fertilizer potential of natural organic waste. Horton, R.; Hawkes, D. *Energy World;* **3**: 5-7(Jun 1976).

The Polytechnic of Wales reports that research work on laboratory-scale and pilot-plant digesters has demonstrated the practicality and commercial viability of producing methane from waste by anaerobic digestion. Based upon well-tried designs that have operated successfully in India, the digester produced about 11 CF of methane per pound of volatile solids obtained from chicken litter (which was 30 percent wood shavings and sawdust). In the process, a slurry containing 10-15 percent solid matter is fed automatically at predetermined intervals into the main digester. Stirring is by gas recirculation, and the separator allows the liquid content to travel through the system in a shorter time than the solids. The liquid residue may be recycled back into the inlet tank and used for watering down the waste, for the process generates more water than it uses. No preliminary screening or maceration of the waste was allowed, ensuring that the mechanisms used were realistically evaluated.

49758 Fermentation process for converting plant materials into methane. Sarma, S.C. Logan, UT; Utah State Univ. (1976). 182p. University Microfilms Order No. 24-70,406.

Thesis (Ph. D.).

A fermentation process for converting plant materials into methane was developed by constructing a two-stage digestor capable of fermenting plant materials into volatile fatty acids which were nutritionally adequate for methane-producing bacteria. Methane production increased with increasing concentration of volatile fatty acids up to a limit of 8000 mg/l above which the pH and methane production declined. A methane digestor loading rate of 2.0 grams of plant acids per day per liter of digestor volume was achieved. Most of the fatty acids in the plant acids were identified by column chromatography. Acid formation was not greatly affected by chopping or grinding the material, and relatively fibrous material such as corn, wheat straw, and cattails yielded smaller amounts of fatty acids compared to alfalfa hay, which gave 320 g fatty acids per kilogram fermented. The gas yield was 295.90 liters per kilogram of alfalfa fermented. The proportion of methane in the digestor gases was more than 50 percent by vol.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 50523, 50653

PREPARATION

PREPARATION FROM WASTES OR BIOMASS

49759 Combined enzyme hydrolysis of cellulose and yeast fermentation. Savarese, J.J.; Young, S.D. (Stevens Inst. of Tech., Hoboken, NJ). *Biotechnol. Bioeng.;* **20**: No. 8, 1291-1293(Aug 1978).

The conversion of cellulose, especially waste cellulosics, into utilizable materials, especially liquid fuel, is a most valuable outcome of cellulase technology pioneered at the US Army Laboratories, Natick, Mass. A process design has been proposed by Wilke for the conversion of cellulosic materials to ethanol and single-cell protein (SCP). The estimated ethanol production cost by this process is at the moment slightly more expensive than ethanol derived from petroleum. This paper deals with a process design improvement which will lower production cost for ethanol obtained via a Wilke or similar type system. We report a process by which the cellulase-catalyzed hydrolysis of cellulose to glucose is coupled with the yeast fermentation of the glucose produced to ethanol and SCP. Both processes take place in the same fermentor thus eliminating the need for the separation of glucose and a second reactor.

49760 Influence of lactose hydrolysis and solids concentration on alcohol production by yeast in acid whey ultrafiltrate. O'leary, V.S.; Sutton, C.; Bencivengo, M.; Sullivan, B.; Holsinger, V.H. (Eastern Regional Research Center, Philadelphia). *Biotechnol. Bioeng.;* **19**: No. 11, 1689-1702(Nov 1977).

Alcohol yields of 6.5 percent were obtained with Saccharomyces cerevisiae in lactase-hydrolyzed acid whey permeate containing 30 to 35 percent total solids. Maximum alcohol yields obtained with Kluyveromyces fragilis were 4.5 percent in lactase-hydrolyzed acid whey permeate at a solids concentration of 20 percent and 3.7 percent in normal permeate at a solids concentration of 10 percent. Saccharomyces cerevisiae efficiently converted the glucose present in lactase-hydrolyzed whey permeates containing 5 to 30 percent total solids (2 to 13 percent glucose) to alcohol. However, the galactose, which comprised about half the available carbohydrate in lactase-hydrolyzed whey, was not utilized by S. cerevisiae, so that even though alcohol yields were higher when this organism was used, the process was wasteful in that a substantial proportion of the substrate was not fermented. For the process to become commercially feasible, an efficient means of rapidly converting both the galactose and glucose to alcohol must be found.

SOLID WASTE FUELS

49761 (HCP/T1726—36/D) **Engineer, design, construct, test, and evaluate a pressurized fluidized bed pilot plant using high sulfur coal for production of electric power. Phase I. Preliminary engineering technology support test results, commercial fluid-bed long term erosion/corrosion test in a municipal sewage incinerator.** (Curtiss-Wright Corp., Wood-Ridge, N.J. (USA)). May 1978. Contract EX-76-C-01-1726. 35p. Dep. NTIS, PC A03/MF A01.

In order to determine the resistance of metal alloys to high temperature erosion-corrosion in fluidized-bed combustors, sub-sized finned tube bundles were installed in operating commercial fluidized-bed reactors used for the incineration of municipal sewage sludge. The alloys tested were Type 304 stainless steel, Incoloy 800H, Incoloy 601, Inconel 690, and Haynes 188. At the end of the test runs there was no visible evidence of deposits or of metal wastage. Metallographic and microprobe analysis revealed shallow internal attack, primarily oxidation, with some slight sulfide penetration. Differences in corrosive attack between alloys was minimal. The sulfidation attack on the tubes was not significant. Possible reasons for this are discussed. (JSR)

HYDRO ENERGY

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 50476

49762 Energy recovery on domestic water supply systems. Horowitz, G.F. (Metropolitan Water District of Southern California, Los Angeles); Hoffman, P.R. *Int. Water Power Dam Constr.;* **30**: No. 5, 32-36(May 1978).

Widespread fuel shortages and the economic impact of increasing fossil fuel costs have prompted a reevaluation of hydroelectric potential previously not considered economically feasible. An appreciable amount of energy is wasted in pressure and/or flow control stations on domestic water distribution systems, and much of this could be recovered using small hydro generating units at some existing "head dissipating" structures. The proposed installation of such facilities on a large water system, where the energy recovered will save the burning of many hundreds of barrels of oil each day, is discussed.

49763 Power from Greenland's glaciers. Partl, R. *Int. Water Power Dam Constr.;* **30**: No. 5, 42-50(May 1978).

In the southern parts of Greenland, large quantities of water melting every summer from the ice shield 1000 m and more above sea level, within a short distance from the coast, provide favorable conditions for large-scale hydropower development. An edited version is presented of a report published by the International Institute for Applied Systems Analysis in Austria which assesses available resources, analyses technical problems for the utilization of the resource and its integration into a global energy system, and estimates construction needs and costs.

SITE GEOLOGY AND METEOROLOGY

REFER ALSO TO CITATION(S) 51317

PLANT DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 50359

49764 Prestressed concrete pressure tunnels. Matt, P.; Thurnherr, F.; Uherkovich, I. *Int. Water Power Dam Constr.;* **30**: No. 5, 23-31(May 1978).

From 8. FIP Congress; London, England (30 Apr 1978).

Since the end of the Second World War, prestressed concrete has undergone a period of turbulent development, attributable predominantly to the intense activity in construction during this period and partly also to the change in the cost structure, which resulted in a shift from steel to prestressed concrete. In lining pressure tunnels and shafts, and in other types of construction, the tendency to move from concrete to steel can be seen. Projects constructed in Italy and Switzerland have recently demonstrated that prestressed concrete can be a complete substitute for the traditional steel lining.

49765 Design of Turkey's Aslantas dam. Vorobjev, I.D. *Int. Water Power Dam Constr.;* **30**: No. 5, 37-41(May 1978).

The Aslantas earthfill dam, part of the Lower Ceyhan multipurpose project in southern Turkey, will have an associated powerhouse of 138 MW capacity, and will provide flood protection and irrigation for the surrounding areas. Project features for the dam and associated structures (particularly the diversion works) are discussed in detail, and current progress at the site is reviewed.

49766 Operation of the Roznow Dam, water reservoir, and hydropower station between 1945 and 1975. Tolwinski, J. *Energetyka;* **32**: No. 3, 121-124(Mar 1978). (In Polish).

49767 Construction of the Roznow Dam and hydro-power station between 1939 and 1945. Tolwinski, J. *Energetyka;* **32**: No. 2, 75-78(Feb 1978). (In Polish).

49768 Development trends in modern hydroelectric power engineering. Hamerak, K. (Fachhochschule Giessen (Germany, F.R.)). *Elektr. Energ. Tech.;* No. 6, 294-297(Nov 1977). (In German).

Three types of turbines are used at present for exploiting waterfalls: Pelton wheels, Francis and Kaplan turbines. Their specific properties and constructional characteristics are described. The development trends are simpler construction, increased safety in operation, construction which makes better use of materials and is therefore lighter and cheaper, transition to larger unit output and increase of the operating head, particularly for Francis and Kaplan turbines.

49769 Control device for the optimum adjustment of the rotating blades of water turbines. Speth, W.; Loeffelmann, F. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,165,635/C/. 5 Feb 1976. 4p. (In German).

The device controls the position of the rotating blades under arbitrarily changing operation temperatures with optimal efficiency or, if desired, minimal loss. It needs less efforts than, for example, a method trying to approach the optimum with periodical test signals and with test steps, the system not stopping even with constant operation parameters. Known elements of control systems are used in suitable combinations. The measured values of power intake and output are used either as quotient or difference of the power intake and output via an identification circuit with a feed-back integrator

for controlling an adjusting element coupled with the rotating blades.

ECONOMICS AND MANAGEMENT

REFER ALSO TO CITATION(S) 49770

ENVIRONMENTAL ASPECTS

49770 Kariba: the dubious benefits of large dams. Balon, E.K. (Univ. of Guelph, Ont.). *Ambio;* 7: No. 2, 40-48(1978).

The ecological consequences of dam building extend far beyond the common cost-benefit analysis. On the Zambezi River for example, a unique and stable ecological system, which took millenia to develop, was rapidly changed by dams into less productive lakes. The process was accompanied by widespread destruction and misery. The production of the electricity required for a more profitable export of mineral resources rendered the local inhabitants dependent on external sources of food, water, etc., where they had formerly been self-sufficient. The surface of the lake reflects more solar energy than the old terrestrial system. As a consequence, fish production is lower than the lost production of plants and game. Species diversity may be increased by natural invasion and artificial introduction, but the production limits of the system can not be changed.

SOLAR ENERGY

49771 (TID—28468) **Proceedings of the national solar energy workshop of the ERDA Division of Solar Energy and the State Energy Offices, held in Huntsville, Alabama, May 19—21, 1976.** Christensen, D.L. (ed.). (Alabama Univ., Huntsville (USA). Center for Environmental and Energy Studies). Oct 1976. Contract EY-76-S-05-5278. 21p. Dep. NTIS, PC A02/MF A01.

This Executive Summary reviews the activities and results of the workshop. The complete agenda is given. (MHR)

49772 Solar energy. Possibilities of solar energy and limits of its use. *Elektro-Handel;* **22**: No. 3, 217-220(1977). (In German).

A general overview is given of the possibilities of using solar energy, in the meteorological conditions existing in the FRG. The initial excessive enthusiasm for this 'free' energy has been replaced by a more sober consideration. Solar energy can be used for hot water supply and suitably designed heating plant (large heater bodies, underfloor heating) in certain periods of the year. Without a conventional heating plant for the colder seasons, the demand for heat cannot, however, be met. Details are given.

RESOURCES AND AVAILABILITY

49773 (CONF-761156—, pp 223-233) **Solar energy for poultry and livestock production: meteorological data collection and application.** Taylor, S.E.; Getz, R. 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

A meteorological data collection, reduction and analysis system was designed to provide environmental data necessary for the evaluation of a solar heat applications study at Auburn University. The parameters of the meteorological environment that affect solar heat collector operation are determined and described. Application of energy balance equations are discussed. The meteorological instrumentation and data collection system at Auburn was designed to be directly applicable to similar projects in other geographical areas.

49774 (COO—4709-1) **Detroit Lakes Energy Systems Study. Quarterly technical progress report, February 1, 1978—April 30, 1978.** DeVillers, K.E. (Western Minnesota Municipal Power Agency, Detroit Lakes (USA)). 8 May 1978. Contract ET-78-G-02-4709. 11p. Dep. NTIS, PC A02/MF A01.

The initial phase of the Detroit Lakes Energy Systems Study was designed to assemble and analyze sufficient data from which to recommend specific classes of alternative energy supplies. Most of the information on meteorological conditions and biomass materials have been obtained. This is being compiled into a useful form for future evaluation. Research into legal and economic areas are underway. Analysis of this data is being conducted and results will be used in assessing the impact of alternative energy systems. Current technical information on solar thermal, solar photovoltaic, wind and hybrid power systems is being evaluated. Potential systems are being considered in light of their impact on the Detroit Lakes region and the northern latitudes in general. Final evaluation of the data is expected well within schedule.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 49775, 49786

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 50506

PHOTOVOLTAIC CONVERSION

49775 (DOE/EDP—0003) **Environmental Development Plan (EDP): Photovoltaics, 1977.** (Department of Energy, Washington, D.C. (USA)). Mar 1978. 53p. Dep. NTIS, PC A04/MF A01.

This Environmental Development Plan (EDP) for the ERDA Photovoltaics Program briefly describes the present status, program goals, and potential applications of photovoltaic technologies and identifies potential areas of environmental concern relevant to both system production and use. Among these concerns are occupational exposure to hazardous substances, environmental effects and possible subsequent public health problems, and socioeconomic impacts. Screening of identified possible impacts results in delineation of those of the most serious, irreversible and cumulative nature, which have near-term importance to the program and for which current knowledge of effects and control technologies are inadequate. In light of these factors, and the length of time necessary to complete applicable research programs, the EDP sets out a management plan, coordinating studies in necessary environmental research areas with the technology development schedule. The principal concerns involve worker exposure to hazardous substances during preparation of semiconductor materials and photovoltaic cells. Besides the major occupational health and safety issues, environmental effects of photovoltaic system development are associated with material production. System malfunction or accidents may involve exposure to toxic gases generated during a fire or system overheat (off-gassing).

49776 (DOE/JPL/954373—4) **Heat exchanger-ingot casting/slicing process. Silicon sheet growth development for the Large Area Silicon Sheet Task of the Low Cost Silicon Solar Array Project. Final report, Phase I, November 20, 1975—November 20, 1977.** Schmid, F.; Khattak, C.P. (Crystal Systems, Inc., Salem, Mass. (USA)). 1 Dec 1977. Contract NAS-7-100-954373. 201p. Dep. NTIS, PC A10/MF A01.

The proof of concept for silicon casting by the Heat Exchanger Method has been established. One of the major hurdles of ingot cracking has been eliminated with the development of graded crucibles. Such crucibles are compatible with the casting process in that the integrity of the container is maintained at high temperature; however, during the cool-down cycle the crucible fails, thereby leaving a crack-free boule. The controlled growth, heat-flow and cool-down has yielded silicon with a high degree of single crystallinity. Even when the seed melted out, very large grains formed. Solar cell samples made from cast material have yielded conversion efficiency of over 9% (AMI). Representative characterizations of silicon grown has demonstrated a dislocation density of less than 100/cm^2 and a minority carrier diffusion length of 31 μm. Excellent surface quality, i.e., surface smoothness and 3 to 5 μm surface damage, was achieved by multiple wire slicing with fixed diamond abrasive. To achieve this, the silicon workpiece was non-synchronously rocked to produce a radial cut profile and minimize wire contact length. Wire wander was reduced an order of magnitude over the original results by supporting and guiding the wires with grooved rollers. Commercially available impregnated wires that were used failed due to diamond pull-out. Plating after impregnation or electroplating diamonds directly on the core minimized diamond pull-out and corresponding loss in cutting effectiveness. Tungsten wire was the best core material tested because of its high strength, high Young's modulus, and resistance to hydrogen embrittlement. A lighter and longer blade carriage can be used for slicing with wire. This will allow the blade carriage to be reciprocated more rapidly to increase the surface speed. A projected add-on cost calculation shows that these methods will yield silicon for solar cell applications within ERDA/JPL cost goals.

49777 (DOE/JPL/954374—5) **Slicing of silicon into sheet material. Silicon sheet growth development for the Large Area Silicon Sheet Task of the Low Cost Silicon Solar Array Project. Eighth**

quarterly report, December 18, 1977—March 19, 1978. Holden, S.C.; Fleming, J.R. (Varian Associates, Lexington, Mass. (USA). Lexington Vacuum Div.). 3 Apr 1978. Contract NAS-7-100-954374. 126p. Dep. NTIS, PC A07/MF A01.

Varian's technique of Multiblade Slurry Wafering of Silicon is shown to be a cost effective means of achieving IPEG cost goals for silicon sheet material. Using conservative estimates for Czochralski grown silicon ingot and the MS wafering technique, sheet prices 10 to 20% below IPEG goals for 1978 to 1982 are described. Recent tests of process variations in MS wafering have proven very unsuccessful. With one exception, variations in abrasive, oil, cutting force, etc. have resulted in reduced wafer yield and accuracy for low kerf loss (200 microns) and thin wafer (250 to 350 microns) slicing of 10 cm diameter silicon. A shift in emphasis is planned in the future. Machine shock loads will be reduced and the effect on yield improvement will be demonstrated. Prior to this series of tests, baseline slicing results will be re-established. Encouraging results have been shown in two areas. Twelve cm silicon ingot was sliced with only 200 to 250 microns of kerf loss and 300 to 350 microns wafer thickness. Improvements in this process are still required. Also, preliminary cutting with a low cost water-based slurry vehicle have shown promise. However, stress corrosion failure of the highly tensioned blades must be eliminated.

49778 (DOE/JPL/954884—1) **Development of advanced methods for continuous Czochralski growth. Silicon sheet growth development for the Large Area Silicon Sheet Task of the Low-Cost Silicon Solar Array Project. Second quarterly progress report, January 1, 1978—March 17, 1978.** Wolfson, R.G.; Sibley, C.B.; Chartier, C.P. (Varian Associates, Lexington, Mass. (USA). Lexington Vacuum Div.). 17 Mar 1978. Contract NAS-7-100-954884. 44p. Dep. NTIS, PC A03/MF A01.

The program has progressed to the final assembly of the recharging system on the Czochralski furnace. All components are in place and functional, and the modified furnace is being tested prior to the start of process development. The feasibility of a 100 kg continuous growth process has been demonstrated by a recharge simulation comprising six melt/pull cycles with a single 20 kg charge; the total body length was 249 cm (98 inch) with a calculated mass of 106 kg. Growth conditions were maintained for 67 hours with neither machine malfunction, excessive SiO accumulation, nor crucible failure. Examination of the crucibles revealed that devitrification and deformation are primarily responsible for the decrease in the wall thickness, which reaches approximately 50% of the minimum starting thickness at the locus of maximum attack--the corner radius. The crucibles also showed no adherence to the residual charge, which may be due to the surface structure produced by the long-term exposure of the silica to molten silicon.

49779 (DOE/JPL/954884—4) **Development of advanced methods for continuous Czochralski growth. Silicon sheet growth development for the Large Area Silicon Sheet Task of the Low Cost Silicon Solar Array Project. First quarterly progress report, October 4—December 30, 1977.** Wolfson, R.G.; Sibley, C.B. (Varian Associates, Lexington, Mass. (USA). Lexington Vacuum Div.). 11 Jan 1978. Contract NAS-7-100-954884. 32p. Dep. NTIS, PC A03/MF A01.

The overall purpose of this two-stage program is the demonstration of continuous Czochralski growth. In Stage 1, an existing Varian 2850 Czochralski furnace is to be modified for continuous growth by recharging; in Stage 2, a new puller is to be designed and shown capable of producing 100 kg of crystal from the same crucible with an after-grind yield of at least 70%. The three components required to modify the Varian furnace for batch and continuous recharging with granular silicon have been designed and are currently being fabricated. The feasibility of extended growth cycles up to 40 hours long has been demonstrated by a recharge simulation experiment; a 6 inch diameter crystal was pulled from a 20 kg charge, remelted, and pulled again for a total of four growth cycles, 59 1/8 inch of body length, and ~65 kg of calculated mass. A preliminary economic analysis indicates that the 1982 SAMICS price goal allocation can be met by sheet production predicated upon the recharging of otherwise standard Czochralski furnaces; the projections are, in 1975 dollars: add-on cost for growth—$37 per m^2, direct poly cost—$46 per m^2, margin available for wafering—$45 per m^2.

49780 (SAND—78-0946C) **Performance of a one kilowatt concentrator photovoltaic array utilizing active cooling.** Burgess, E.L.; Pritchard, D.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 3p. (CONF-780619—5). Dep. NTIS, PC A02/MF A01.

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Operational experience on a 1-kW concentrating photovoltaic array incorporating silicon solar cells and Fresnel lenses is reported. The array was operated in two modes of active cooling. The first mode provides cell cooling by pumping water through tubes attached to the heatsink behind the solar cells. The array is also cooled in this mode by natural convection from both the front and back of the heatsink. The second mode of active cooling involves operating the array as a combined thermal/electrical system. In this combined thermal/electrical mode approximately 58% of the incident solar energy can be collected for thermal and electrical utilization.

49781 (SAND—78-1191C) **Combined photovoltaic thermal collector testing.** Smith, D.R.; Biringer, K.L.; Pritchard, D.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 6p. (CONF-780619—8). Dep. NTIS, PC A02/MF A01.

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A commercially available liquid-cooled thermal flat-plate collector was modified by the addition of 104 silicon cells in four parallel strings extending almost the entire length of the collector front surface. The electrical efficiency of the cell array was measured as a function of temperature for three different flow rates corresponding to temperature differences between inlet and outlet coolant ranging from 4°C to 38°C. The data showed a linear decrease in electrical efficiency with the temperature of the panel surface measured halfway between inlet and outlet ports. The efficiency-temperature relationship was independent of the temperature gradient. The thermal efficiency also exhibited a linear decrease with increasing difference between inlet coolant temperature and ambient temperature. The measured array efficiency (8.1 percent at 27°C) was comparable to the measured efficiency of a single cell from the same lot.

49782 (TID—28458) **Preliminary analysis of an option for the Federal Photovoltaic Utilization Program (FPUP).** (BDM Corp., McLean, Va. (USA)). Nov 1977. 54p. Dep. NTIS, PC A04/MF A01.

The purpose of this study is two-fold: (1) It addresses comments made by various Federal Agencies and private industry on a previous study completed by the contractor entitled "DOD Photovoltaic Energy Conversion Systems Market Inventory and Analysis;" and (2) it expands the original analysis of the study. In the aforementioned study, the contractor developed a cost-benefit analysis of the Federal Photovoltaic Utilization Program. The intention of the Program is to provide significant, cost effective incentive for the accelerated development of an innovative highly competitive industry capable of producing low cost, quality, photovoltaic systems. This industry would be capable of supplying the private sector with a major source of clean, nondepletable electrical energy. As a secondary benefit, the Federal government is expected to realize significant net cost savings. The option analyzed in this report would consist of a series of federal procurements resulting in the installation of 152 magawatts peak of photovoltaic arrays over a five year period.

49783 **Electronic characterization of indium tin oxide/silicon photodiodes.** Chang, N.S.; Sites, J.R. (Physics Department, Colorado State University, Fort Collins, Colorado 80523). *J. Appl. Phys.;* **49**: No. 9, 4833-4837(Sep 1978).

Photodiodes of indium tin oxide deposited on single-crystal p-silicon are analyzed with respect to their electronic properties. Dark measurements include the current and capacitance dependences on voltage and temperature. Photocurrent measurements reveal the relationship to the illumination intensity, temperature, and wavelength of light. Analysis reveals a relatively large, but temperature-dependent, built-in voltage and a small interface recombination probability.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 49758, 49774, 50506

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 49775

SOLAR THERMAL POWER PLANTS

49784 **Can 'solar electricity' be generated economically. Comparison between a fossil-fired and a solar 20 MW steam power plant in a sunny region.** Meinhardt, H. *Elektr. Energ. Tech.;* **22**: No. 2, 61-64(1977). (In German).

A comparison is made between a fossil-fired 20 MW steam power plant and a corresponding solar steam power plant, assuming that the latter lies in a sunny region. The comparison is concerned above all with the different cost balances of the two power plants. With regard to the solar power plant, problems concerning the site and the principal layout are discussed, too. Finally, economic aspects of the export of solar power plants by industrial countries and their

importance for the economic growth of developing countries are discussed.

49785 Optimal overall efficiency for a solar radiation collector utilizing a two fluid Rankine cycle to generate electrical power. Cobble, M.H.; Smith, P.R. (New Mexico State Univ., Albuquerque). pp 308-313 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Equations for concentration, mirror efficiency, and collector efficiency are developed and solved numerically for an absorber tube, enclosed by a partially silvered glass envelope, placed at the focus of a parabolic mirror. Utilizing a thermal storage boiler, an expression for the overall efficiency of a system using the collector, the thermal storage boiler, and a two fluid Rankine Cycle to generate electrical power is derived and solved numerically to determine the optimum operating condition for this system.

CENTRAL RECEIVER

49786 (SAND—78-6013) **Air navigation hazards associated with a central solar tower.** Sicart, F.; Gentili, B. (Centre National de la Recherche Scientifique, 75 - Paris (France); Elcon Lab., Inc., Peabody, Mass. (USA)). Apr 1978. Translation by P. Newman of THEM—77-41, Aug 1977. 46p. Dep. NTIS, MF A01.

Portions of document are illegible.

The risks of interception by an aircraft flying over a central solar electric plant have been examined from two points of view: (a) dazzlement of the pilot and passengers; (b) damage to the retina. The conditions foreseen for the Saint Chamas site for the various types of equipment can be summarized as follows: (a) overflight by commercial navigation 470 m above the field; (b) floor of military navigation fixed at 1000 m above the field, and (c) occasional overflight by general navigation 300 m above the field. The latter type of aircraft thus appears a priori to have the greatest risks, but the presence of the Marignane approach corridor severely limits traffic of this nature. The most important perturbation that a solar central station at Saint Chamas could create for aerial navigation is the risk of dazzlement to a commercial aircraft caused by accidental misalignment of a heliostat. This could be the result when a beam is intercepted by an aircraft; the probability of such an interception has been evaluated at 10^{-6}, under the following very pessimistic hypotheses: (a) establishment of the dazzlement threshold at 1 sun; (b) permanent loss of control of one heliostat on an average over the entire lifetime of the station; and (c) the screening effect produced by the nose of the aircraft is not taken into account; considering this effect should in fact reduce the risk very significantly. This probability would then predict one such occurrence in 14 years under the traffic conditions foreseen for 1985. Occasional overflight at 300 m could lead to a higher risk of dazzlement. But in any case this dazzle will not inflict any damage on the pilot's retina. Finally the experimental programs planned in Albuquerque by ERDA and in Odeillo should allow evaluation of the effects on a pilot of a considerable reflected solar flux (surprise, dazzle) and the probability of unfavorable consequences, until now considered equal to unity.

TOTAL ENERGY AND HYBRID SYSTEMS

49787 (SAND—78-0329) **Operational interface control drawing procedure for STE-LSE, Shenandoah.** Kinoshita, G.S. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

This document defines the procedures for identifying, coordinating, controlling, evaluating, distributing, and maintaining status control of interface design constraints that apply to the Solar Total Energy-Large Scale Experiment, Shenandoah. Specifically, procedures are defined to address the GPC/DOE interface control drawings which reflect agreements by their designated agencies. Interface design considerations as described in this document are co-functioning, interdependent, or interacting design parameters at the interfaces between participants. This procedure may also apply to interface control drawings for selected interfaces where a single participant controls the design of both sides of the interface (end items hardware).

OCEAN THERMAL GRADIENT POWER PLANTS

49788 (DOE/EDP—0006) **Environmental Development Plan (EDP): Ocean thermal energy conversion, 1977.** (Department of Energy, Washington, D.C. (USA)). Mar 1978. 48p. Dep. NTIS, PC A03/MF A01.

This Environmental Development Plan (EDP) for the Energy Research and Development Administration's (ERDA) Ocean Thermal Energy Conversion (OTEC) Program briefly describes the present status and goals of the program and identifies potential environmental, health, safety, and socioeconomic impacts relevant to OTEC. These impacts are screened for "key issues," i.e., those which are considered to be most serious in nature, which have near-term importance to the program, and for which current knowledge of effects and control strategies is inadequate. A management plan then is presented for conducting and coordinating environmental research in concert with the technology development effort. This will ensure that identified environmental issues are resolved prior to significant public utilization of OTEC systems. The nine key issues associated with OTEC deployment are: ocean water mixing; metallic discharges; impingement/entrainment; use of biocides; working fluid leaks; climatological impacts; worker safety; international law; and secondary impacts.

49789 (LMSC-D—562046) **Ocean Thermal Energy Conversion (OTEC) development of an apparatus to measure biofouling effects on heat exchangers in ocean environments. Design report.** (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA). Ocean Systems Div.). Oct 1977. Contract EY-76-C-06-1830. 143p. Dep. NTIS, PC A07/MF A01.

Portions of document are illegible.

In March 1977, Pacific Northwest Laboratory of Battelle (BNW) negotiated a contract with LMSC to design, fabricate, and proof test an apparatus that is intended for use in (1) establishing the severity of the biofouling problem and its effect on heat transfer under OTEC operating conditions, (2) measuring the effectiveness of potential countermeasures, and (3) obtaining accurate heat transfer data that will be used in the design of OTEC heat exchangers. The contract has three tasks: Task I Design of the Apparatus, Task II Fabrication and Laboratory Testing of the Apparatus, and Task III Ocean Testing of the Apparatus. This report discusses Task I—Design of the Apparatus, which is now complete. The system incorporates thermoelectric modules to provide the heat flux and thermistors for temperature monitoring. Design, calibration, and operation of the test device are described, and drawings are included. (WHK)

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 49883, 50467

49790 Utilization of solar and wind energy to improve the living environment in less developed countries. Ramakumar, R. (Oklahoma State Univ., Stillwater). pp 314-318 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Availability of small-scale energy systems in remote rural communities in less developed countries can provide the basic needs of life and considerably improve the living environment for millions of people. The prospects of utilizing renewable energy sources such as solar and wind energy to achieve this goal is discussed and a systematic approach to develop viable rural economic units in such countries is presented.

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 50521, 50589, 50591

49791 Cost optimization of solar heating of buildings in northern regions. Willcutt, G.J.E. Jr.; Hunn, B.D.; McSweeney, T.B. (Los Alamos Sci Lab, NM). *Am. Soc. Mech. Eng., [Pap.]*; No. 75-WA/Sol-9, vp(1975).

A detailed computer model has been developed to simulate the performance, on an hourly basis, and to optimize the cost of solar heated buildings in northern regions characterized by cold and/or cloudy climate. The present model includes improvements in the original model Canadian cities (Vancouver, B.C.; Edmonton, Alta.; Winnipeg, Man.; Ottawa, Ont.; and Fredericton, N.B.) for the years 1970 and 1971. For each simulated year the system cost is optimized as a function of collector size for representative values of the other system parameters (storage size, number of glazings, etc.). Annual combined solar/conventional system costs are determined with collector cost and conventional fuel cost as parameters. Comparison is made between the effects of the amount of insolation received, cloud cover, and severity of the heating demand on system performance and cost.

49792 (CONF-761156—) **Proceedings of symposium on use of solar energy for poultry and livestock production.** (Auburn Univ., Ala. (USA)). 1976. Contract EG-77-G-05-5346. 252p. Dep. NTIS, PC A12/MF A01.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

Separate abstracts were prepared for the eighteen papers for inclusion in ERA. Two papers were selected for EAPA. (MHR)

49793 (CONF-761156—, pp 25-35) **Maryland solar energy research as related to poultry: an update.** Carr, L.E.; Felton, K.E.; Merkle, J.A.; Cain, J.; Brinsfield, R. (Univ. of Maryland, College Park). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

In 1975 more than 130,000,000 gallons of propane or its equivalent were used to heat commercial broiler houses in the United States. A project designed to test the feasibility of substituting solar energy for propane is described. A dual-loop solar system has been designed, constructed, and retrofitted to an existing 1000 bird environmental research chamber at the University of Maryland Broiler Research Facility at Salisbury. A schematic of this system is shown. Incoming solar data are tabulated and sample of hourly temperature readings for the collector and heat exchanger are provided. Examples of incoming solar energy records for various days between February 5 and March 22, 1976 are presented. (MHR)

49794 (CONF-761156—, pp 37-38) **Solar poultry brooding research at the Southeast Poultry Research Laboratory.** Drury, L.N. (Southeast Poultry Research Lab., Athens, GA). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

The objectives of this research are to: (a) design, construct, and test the performance of a practicable system for collecting, storing, and using solar energy as a partial substitute for fossil fuel energy for brooding and rearing broiler chickens in the southeastern United States; (b) demonstrate the technical feasibility of such a system; (c) determine the relative amounts of fuel that can be saved in different seasons of the year by using a solar supplemented brooding system rather than a 100 percent gas-heated system; and (d) make the findings and recommendations from this research available to prospective users. The solar brooding research facility consists of two small, identical broiler houses and an adjacent auxiliary building which supports the solar flat-plate collectors and houses the heat storage tanks, pumps, controls, and instruments. In most of the experiments, the brooding heat for one house will come mostly from the sun, while the heat for an identical brooding system in the other house will come entirely from LP gas. Each of the well-insulated, windowless, fan-ventilated houses can be subdivided, by fold-up partitions, into three pens. This will facilitate the energy-saving practice of reduced-area brooding.

49795 (CONF-761156—, pp 40-77) **Poultry house heating and manure drying utilizing solar energy.** Brown, W.H.; Forbes, R.E. (Mississippi State Univ., MS). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

A low-cost solar air heater was constructed on an existing poultry building at Mississippi State, Mississippi. Air flow channels below the galvanized roof were formed by covering the underside of 2 in. x 4 in. purlins with 1 in. polyurethane and $1/4$ in. plywood. The galvanized roof was painted with heat resistant flat black paint and glazing was supported $1/2$ in. above the corrugation peaks. Total collector area was 720 sq ft; one-half covered with 2 ft by 3 ft double strength glass and one-half covered with 0.060 in. 4 ft by 8 ft Lexan. A variable speed blower circulated air through the collector and air flow was measured with a Thomas meter. A two-belt counter-flow dryer was constructed for manure drying using the heated air. Both belts were constructed of teflon-coated fiberglass cloth. A simple hopper with an adjustable slot feeds manure onto the upper belt. Manure at approximately 80 percent m.c. was dried to the 30 to 40 percent m.c. range, short of the design goal. An adjacent caged layer house was heated with air from the solar collectors and temperatures recorded with thermocouples and a data-logged system. Small temperature increases resulting from heating were noted in the house during the daylight hours, but a larger increase was recorded during the night hours after heating. This suggests that substantial amounts of heat are stored in the building walls and equipment and returned to the house interior at night.

49796 (CONF-761156—, pp 80-89) **Livestock shelters solar energy program. Poultry house heating and manure drying utilizing solar energy.** Reece, F.N. (South Central Poultry Research Lab., Mississippi State, MS). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

Research was initiated to (a) develop, cooperatively with Mississippi State University, methods for converting conventional poultry house roofs to solar collectors, and use the collected energy to heat a laying hen house and to dry manure, and (b) develop a solar energy system for use in conjunction with limited-area brooding and growing of broiler chickens. The roof of a 40-ft x 36-ft section of a poultry house was modified to collect solar energy, and the collected solar energy applied to manure drying and layer house heating. A solar energy collection system using both water heater and air heaters was designed and attached to a broiler chicken growing house. In the initial trial, conducted during midwinter, 3600 chickens were brooded and grown to market age using a total of 8.2 gallons of liquified petroleum gas per 1000 chickens, which was a reduction of 73 percent of the fuel required in this house in previous tests under similar conditions but without the solar assist.

49797 (CONF-761156—, pp 117-124) **Solar energy utilization in poultry production: Auburn University.** Flood, C.A. Jr.; Koon, J.L. (Auburn Univ., AL). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

A fuel use survey and feasibility analysis are described covering three sub-projects: fuel use survey and analysis, energy use analysis, and solar systems analysis. The design and construction of a solar energy research facility are described including a solar resource poultry house, a solar heating system and a data monitoring system. (MHR)

49798 (CONF-761156—, pp 125-137) **Use of solar energy in a modified open-front finishing unit.** DeShazer, J.A.; Moser, B.D.; Teter, N.C. (Univ. of Nebraska, Lincoln). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

A popular swine growing--finishing building is one that is completely enclosed during the winter but can be opened on the south during the warm months. This type was altered for utilizing solar energy. Data are presented for room temperature, collector efficiency, and the effect of supplemental solar heating vs all electric heating on performance of growing—finishing pigs from January 23 to April 16, 1976, Mead, Nebraska. Photographs and sketches of the solar systems are shown. (MHR)

49799 (CONF-761156—, pp 139-151) **Solar energy for preheating ventilating air (swine buildings).** Spillman, C.K.; Robbins, F.V.; Koch, B.A. (Kansas State Univ., Manhattan). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

The solar energy collector-storage unit is 8′ high and 50′ long with a net collecting area of about 380 sq ft. It is parallel to and 16″ in front of the existing south wall of the farrowing barn on the Kansas State University Agricultural Experiment Station. Its main features are a massive wall painted black on the south side with openings from front to back, and a double transparent cover on a frame that allows ventilating air to pass between the covers as it enters the system. Moving air through the space between the covers allows the air to pick up some of the heat that would be lost. The air removes heat from the south side of the blocks first and cools the surface to further reduce heat loss from the storage.

49800 (CONF-761156—, pp 153-168) **Optimizing solar energy for modification of farrowing house environments.** McFate, K.L. (Univ. of Missouri, Columbia). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

The design and progress in the construction of a solar heating system for one wing of the University of Missouri farrowing house are described. Problems are discussed. Drawings of the design are given. (MHR)

49801 (CONF-761156—, pp 169-179) **Solar energy research in swine housing in Virgina.** Vaughan, D.H.; Bell, E.S.; Hill, C.L.; Holmes, B.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

A small swine nursery building has been constructed and fitted with a water-to-air heat pump heating system. Heat is provided to the heat pump from flat plate solar collectors when solar insolation is available and from a swine waste lagoon at other times. The system is working adequately with inlet water temperatures within the design temperature limits of the heat pump. Attempts are being made to allow the heat pump to operate outside of the design range. Studies are being conducted to find cost effective ways of increasing heat pump inlet water temperature so that heat pump operating COP will be improved.

49802 (CONF-761156—, pp 181-195) **Solar thermal energy utilization in the milking parlor.** Hayden, M.B.; Thompson, P.D. (Beltsville Agricultural Research Center, MD). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

The solar energy project at the Beltsville Agricultural Research Center is designed to supplement the energy supply of the milking parlor. During recent operation the system recovered an average of 250 kw-hrs from 93 m^2 of flat plate solar collectors mounted on the milking parlor roof in a 6 hr sunny day. Thermal energy is collected by pumping water through the collector surfaces, and is either stored in an underground tank or immediately utilized by fan coil units in the milking pit, or used to preheat water going to the domestic hot water heater. Since installation of the solar heating system, electrical requirements of the electric water heaters have been significantly reduced from their previous value. In addition to supplementing the energy supply to the parlor, the system supports investigations dealing with corrosion prevention techniques and system optimization.

49803 (CONF-761156—, pp 197-206) **Appraisal of solar heating: the industry and its' technology.** Dunn, J.R. (Texas Tech. Univ., Lubbock). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

A brief appraisal is presented of the solar energy industry, its technology, and those factors important to its potential use in livestock production facilities. Incentives for using solar energy are discussed along with the disadvantages. The probable outlook for solar space heating is mentioned. (MHR)

49804 (CONF-761156—, pp 217-222) **Corrosion problems in solar energy systems.** Thompson, P.D.; Hayden, M.B. (Beltsville Agricultural Research Center, MD). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

Solar heating systems are similar to conventional water or space-heating systems. However, solar heating systems are characterized by higher first cost so that equipment life is a key factor in establishing their economic practicality. Corrosion of system components, particularly of aluminum water passages in solar heat collectors, is the main factor which limits system life. Techniques for reduction of corrosion damage include water treatment, control of dissolved oxygen, avoidance of galvanic couples, and use of sacrificial "getter" columns.

49805 (CONF-761156—, pp 235-245) **Economic appraisal of use of solar energy in broiler production.** White, M. 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

Through the use of research results from a potential solar conversion system and from currently relevant cost data, the economic feasibility of solar energy use in broiler production was examined. Partial-house brooding with lowered ceiling and well insulated brooding area can contribute to a 40-45 percent saving in fuel. Production cost per thousand could be reduced approximately 10 percent. When a solar unit is installed in a multi-stage broiler brooding system there was a saving of almost 80 percent in the amount of fossil fuel needed. Production cost per thousand broilers was reduced about 16 percent from that for single-stage brooding using a solar unit. Although it was estimated that the volume of fossil fuel used could be reduced 75 percent by the installation of a solar unit in single stage brooding, production cost per thousand was increased by almost 9 percent. Brooding by means of solar energy does not appear to be economically feasible with present brooding management practices. (MHR)

49806 **Solar heat pump systems: an analysis.** Hurley, J.P. *Sol. Heat. Cool.;* **3**: No. 3, 21-25(Jun 1978).

A brief review of the heat pump system is given. The use of a solar-assisted heat pump and the use of a heat pump-assisted solar heating system are discussed. Both systems employ the use of a swimming pool. (MOW)

49807 **Heat pump.** Baier, W. *Bild Wiss.;* **15**: No. 1, 66-76(Jan 1978). (In German).

After a brief explanation why there is only a small chance in the Federal Republic of Germany for space heating only by solar energy by means of solar cells or collectors, the importance of using heat pumps is pointed out by means of some examples. Among others, the Junkers 'Tritherm-House' is described, where solar collectors, heat pump, and supplementary heating system are being operated jointly, controlled by a computer. A part from improvements of the collector efficiency gained by using heat pumps, air, soil, and groundwater can be used as supplementary heat sources, so that thermal requirements of a house can be covered completely at 83% of all days during the heating period.

49808 **Solar plant with heat pump and waste heat utilization.** Baier, K. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 6, 40-41(Nov 1977). (In German).

An energy supply plant for a workshop and residential building is described. The already existing heating system was extended by a solar plant with heat pump while at the same time making use of the process waste heat of the welding facilities. Apart from this, a waste oil combustion plant was included in the overall concept. The costs for the extension amounted to DM 200,000. During the first year of operation more than 20,000 l fuel oil were saved.

49809 **Solar architecture today. Four examples of planning, which are discussed in the working group 'Architectural integration of solar plant'.** Urbanek, A. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 6, 6-9(Nov 1977). (In German).

The possibility of using the environmental heat and solar energy for heat supplies and air conditioning of buildings requires the architects and constructional engineers to adapt to a new process in many respects. The article shows the problems in the field of 'architectural integration of solar plant'. The following 4 projects representing a crossection of the normal sizes of buildings are discussed: 1) Detached house, 2) Integrated group of detached houses, 3) Industrial buildings, 4) Office blocks.

49810 **Metal roof as solar absorber. Promising concept for low temperature heat/price per sq. metre from DM 68.** Urbanek, A. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 6, 43-45(Nov 1977). (In German).

A new concept for providing energy for supplying a house is described. Instead of the usual flat collectors, the whole roof is made of a metal sheet. The solar energy absorbed by the roof is conducted by a heat transfer medium and is either taken directly to underfloor heating or is taken to a ground store. The total system is coupled to a heat pump. The plant covers the complete heat demand of the house, which is 65,000 kwh/annum. The total annual power costs for the house with 410 sq metres of living space are DM 1,300.00.

49811 **Bivalent heating system for new hotel. 118 m^2 collectors + 4 heat pumps installed.** *Oel- Gasfeuerung;* **22**: No. 8, 406-410(Aug 1977). (In German).

A bivalent heating and water heating system was installed in a hotel just built. Solar energy is to be used; in a bivalent phase of operation, heat pumps, whose evaporator preheat is led via the collectors into a store, arare used. Details of the overall concept are presented.

49812 **Solar heating and cooling of a 25,500 square foot building.** San Martin, R.L. (New Mexico State Univ., Las Cruces); Bridgers, F.; Diamond, S. pp 298-302 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

The New Mexico Department of Agriculture building is both solar heated and solar absorption cooled. This project, which had been in preparation for two years, was completed in September 1975. In its preliminary analysis, both a solar heating and solar absorption cooling system and a solar heating and heat pump system were considered. The system utilizes 6,730 sq. ft. of two different types of solar collectors. One being of flat plate design with a selective surface and the other being a ten-to-one concentrator with an automatic tracking system. This single story building utilizes 30,000 gallons of pressurized water as storage in two underground tanks, allowing for multiple modes of storage. A modeling study indicates that the solar system will provide 79% of the annual heating and cooling requirements of this building. The building is being carefully instrumented to monitor its performance.

49813 Continuous solar air conditioning with ammonia/water absorption cycle. Farber, E.A.; Morrison, C.A.; Ingley, H.A.; Clark, J.A. (Univ. of Florida, Gainesville). pp 319-321 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Recently, two studies involving solar air conditioning were completed at the University of Florida Solar Research Residence. One investigation provided information on the construction and operation of an intermittent ammonia/water absorption air conditioning system. This unit was used to cool the Solar Research Residence. Concurrent with this study, a continuous ammonia/water absorption machine was being investigated at the University of Florida Solar Laboratories. A brief analysis of the continuous ammonia/water absorption cycle is presented. Data are presented on the operation of the continuous absorption unit. A design will also be presented illustrating the operation and spacial arrangement of the hardware required for cooling a typical residence with a solar powered, continuous ammonia/water absorption air conditioner.

49814 Comparative study of the effectiveness of baseboard convectors versus forced air solar heating at the University of Florida solar house. Farber, E.A.; Morrison, C.A.; Ingley, H.A.; Tarud, F.J. (Univ. of Florida, Gainesville). pp 322-328 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

The solar research residence is heated with hot water furnished by solar flat plate collectors. A storage tank provides the thermal inertia required to provide heating during inclement weather. Data have been collected for several heating seasons and comparisons have been made with energy consumption data collected when the house was heated by conventional means (electric and gas). Two methods of introducing heat into the house were studied: (1) baseboard convectors and (2) forced air by means of a fan/coil combination. Some of the comparative data developed during the study discussed above are presented. Results from the baseboard studies and the forced air studies are compared. These combined results are also compared with the data gathered when the house was heated by conventional means. Schematics and photographs of the solar heating systems are also presented.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 49795

49815 (CONF-761156—, pp 91-116) **Drying animal wastes with solar energy.** Baerdemaeker, J.D.; Horsfield, B.C. (Univ. of California, Davis). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

The feasibility of using solar energy directly to dry poultry manure was measured experimentally and studied analytically. A computer simulation of the moisture evaporation was performed based on the energy balance of a thin layer of manure. A mini-weather station was installed on-site to collect weather information required by the simulation model. An experimental drying bed with an area of 155 square meters was constructed on a 180,000 layer commercial poultry ranch. This inexpensive drying bed lies between two tracks over which a programmable mechanical agitator travels for stirring of the manure. During drying, samples were taken for determining the moisture content as a function of time and for comparing the measured evaporation rate with the calculated values. It was found that manure loading density and stirring rate were important parameters. Also, the measured drying rates were lower than calculated values. Manure with an initial moisture content of 56.5 percent (wet basis) was spread out at a rate of 45 kg/m^2 and dried to 18.2 percent (wet basis) in 34 hours (2 days, 1 night). Analysis of N-content in samples during a 3-day drying period did not show any appreciable N-loss. Considerable fossil fuel savings from solar drying of manure are possible.

WATER HEATING

REFER ALSO TO CITATION(S) 49802, 49806, 49811, 49833, 50589, 50591

49816 (TID—28516) **Double-exposure collector system. Technical progress report, January 1, 1978—March 31, 1978.** Larson, D.C.; Savery, C.W. (Drexel Univ., Philadelphia, Pa. (USA)). 25 Apr 1978. Contract EG-77-C-04-4089. 10p. Dep. NTIS, PC A02/MF A01.

A retrofit solar water-heating system has been installed in a three-story apartment building at Drexel University. The system employs two conventional collector banks (10 PPG collectors) mounted at the latitude angle for Philadelphia of 40° from the horizontal and two double—exposure collectors (DEC's) mounted vertically in mirrored enclosures. Although the DEC units are being used for year-round domestic water heating for the building, they are designed to provide maximum output in the winter and are therefore well-suited to solar space heating applications. Instrumentation for testing the DEC units has been developed and installed in the apartment building. This instrumentation will allow a complete testing program to begin. At present only preliminary operating results have been obtained which have been very promising.

49817 Open-air swimming bath at Eggersdorf with solar heating. Economy proved after the first full year of operation, 1977. Braeunlich, G. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 6, 25-26(Nov 1977). (In German).

An open-air swimming bath with solar heating was opened at Eggersdorf (Austria) in July 1976. The collector surface is 536 sq metres. After one year's operation one can make the first statement on the economical viability of the plant. The investment costs, at 1.5 million Austrian shillings, are twice as high as for normal heating, but the annual power costs are only 3,000 Austrian shillings. A normal plant would have annual power costs of about 200,000 Austrian shillings. A graphical representation shows the water temperature for the months May - September. Technical explanations of the collectors used and the control of the plant are given.

49818 Solar convector for the utilization of solar (UV) radiation for the generation of heating energy, hot water, or electric power. (to Anlagenbau Berberich G.m.b.H., Stolberg (Germany, F.R.)). German(FRG) Patent 2,602,387/A/. 28 Jul 1977. 15p. (In German).

The flat plate collectors described are constructed the traditional way. The absorber surface consists of individual elements, curved towards the inside, which makes the absorption surface bigger. The right- or left-hand rotated circulation pump connects the absorber system up with the existing heating system, and thus it can be emptied as described. Some examples of application are presented.

49819 Collector types and their different constructional characteristics. Bossel, U. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Goettingen (Germany, F.R.)). *Sanit. - Heizungstech.;* No. 10, 628-631(1976). (In German).

Three components form the core of every solar heating plant: The collector which is the component collecting the heat, the store as a heat buffer and the heating system which is the heat emitting element. As an example, underfloor heating acts as the heating system. The problem of storage is not solved, while collector development has just begun. In the interim phase, which will last for some years yet, one will be able to combine them, without storage, with low temperature heaters to form functional plants.

OTHER

49820 Plant for using solar heat. Haaf, S.; Wille, W.; Gruber, F. (to Linde A.G., Wiesbaden (Germany, F.R.)). German(FRG) Patent 2,550,413/A/. 18 May 1977. 14p. (In German).

The invention concerns plant for using solar heat, where the heat collected in a solar collector is given up via a working medium pumped round the circuit, and is converted into useful energy, preferably electrical energy, within this circuit. A low pressure cooling medium is used as heat transport medium, which takes away the heat energy obtained in the collector. This cooling medium evaporates in the solar collector and is then reduced in pressure in a screw expansion machine. After condensing in a condenser, the cooling medium is returned to the collector. The kinetic energy gained in the expansion machine is converted into electrical energy in a generator. In order to be able to operate the plant during periods of little sunshine, a directly heated thermal store, e.g. a rock store can be included in the circuit of the working medium, which takes up excess energy in periods with plently of sun.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 49780, 49781, 49785, 49810

49821 (CONF-761156—, pp 207-216) **Solar collector material.** Forbes, R.E. (Mississippi State Univ., MS). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

Materials for solar collectors for space conditioning of poultry and livestock shelters are considered. The solar collector components discussed are: absorber material surface, absorber coatings, collector glazing materials, insulation, and miscellaneous (sealants, etc.). (MHR)

49822 (COO—2597-4) **Methods for reducing heat losses from flat plate solar collectors: Phase II. Final report, February 1, 1976—August 31, 1977.** Hollands, K.G.T.; Raithby, G.D.; Unny, T.E. (Waterloo Univ., Ontario (Canada)). Mar 1978. Contract EY-76-G-02-2597. 84p. Dep. NTIS, PC A05/MF A01.

Improvements to flat plate solar collectors for heating and cooling of buildings were investigated through two parallel studies. The first study, which deals with the free convective heat loss from V-corrugated absorber plate to a plane glass cover, has shown that, for the same average spacing, the free convective heat loss is greater for a V-corrugated absorber plate than for a plane absorber plate. However, provided the average spacing is large enough, the amount of increase is slight. The second study, which deals with the free convective heat loss in a honeycomb solar collector in which the honeycomb consists of a set of horizontal partitions, or slits, has shown that provided the solar collector is tilted to near vertical, such a honeycomb gives equivalent or superior free convective loss suppression than does a square-celled honeycomb having the same amount of material. Correlation equations for the free convective heat loss are given for both studies.

49823 **Solar absorber panel.** Rowland, R.S. (to Tranter, Inc.). US Patent 4,086,910. 2 May 1978. Filed date 14 Apr 1976. 4p.

The panel, as constructed of two plates or sheets marginally seam-welded together and subdivided internally into parallel longitudinal flow passages between vertically spaced inlet and outlet fittings, provides for a well distributed, low-volume flow of an appropriate heat transfer liquid therethrough, preferably from bottom to top thereof. In one illustrated embodiment, such equalized flow distribution is insured by restricted central throat or diverter formations lying between the respective fittings, hence the opposed inlet and outlet ends of said longitudinal flow passages. Moreover, the center-most of said flow passages is longer than those at either side thereof, which progressively decrease in length to the side-most thereof, so that said header spaces incline mildly downwardly in reference to the vertical. This contributes to improved drainage of the panel when desired; it also tends to make for an even distribution as to the vertical flow. In another embodiment, the inlet and outlet fittings are located adjacent diagonally opposite corners of the panel, with the opposite end header spaces sloping unidirectionally across the entire interior width of the plate unit. Diverter formations adjoin the fittings, as in the first form.

49824 **Solar energy collector.** Brin, R.L.; Pace, T.L. (to Department of Energy). US Patent 4,067,316. 10 Jan 1978. Filed date 22 Oct 1976. 4p.

PAT-APPL-734,839.

The invention relates to a solar energy collector comprising solar energy absorbing material within chamber having a transparent wall, solar energy being transmitted through the transparent wall, and efficiently absorbed by the absorbing material, for transfer to a heat transfer fluid. The solar energy absorbing material, of generally foraminous nature, absorbs and transmits the solar energy with improved efficiency.

49825 **Solar collector with evacuated absorber cover pipe.** Mahdjuri, F. (to Philips Patentverwaltung G.m.b.H., Hamburg (Germany, F.R.)). German(FRG) Patent 2,612,171/A/. 29 Sep 1977. 15p. (In German).

The invention refers to a solar collector with an evacuated, transparent absorber cover pipe closed at the ends. The cover pipe is provided on the inside over the whole of the length of the cylinder and over a crossectional area of at least 180° with a selectively heat reflecting layer. To avoid radiation losses, at least one front surface of the cover pipe is covered with a metallic mirror surface. The mirror surface consists of metal or metal alloy with low heat emission, e.g. of gold, silver, aluminium, lead, or copper. The mirror surface is annealed.

49826 **Solar energy heated closed or open container for general purpose.** Piffko, H. German(FRG) Patent 2,608,328/A/. 1 Sep 1977. 8p. (In German).

The invention has the purpose of providing containers in which solid, liquid or gaseous materials can be stored, and which are so arranged that they can be heated or kept at a certain temperature using solar energy. The containers are constructed wholly or partly from two or more walls. The outer jacket is made of material having great transparency to light and low reflecting effect. Below the jacket there are gas cushions. The actual absorber layer is situated below this. The back of the container can consist of heat insulating material. Finally some applications for such containers are described.

49827 **Process for operating a collector system for solar radiation and equipment for carrying out the process.** Robinson, G.P. Jr.; Shelton, S.V.; Hutchins, S.F. (to Scientific-Atlanta, Inc., Atlanta, Ga. (USA)). German(FRG) Patent 2,707,803/A/. 1 Sep 1977. 45p. (In German).

The invention refers in general to solar collector systems in which the heat transfer liquid flows down a flow channel under gravity and is heated by solar radiation. The collector consists of a large number of collector pans of standard construction, which are connected in series. The heat transfer liquid flows in the flow channel as a thin film. In this way, the heat transfer liquid spreads over the whole floor surface of the heat transmission channel, so that a maximum of solar energy can be absorbed. The heat transfer liquid also has a low partial vapour pressure, so that losses by evaporation are avoided.

49828 **Wall material for cell structure to avoid heat losses in solar collectors.** Hussmann, E. (to Jenaer Glaswerk Schott und Gen., Mainz (Germany, F.R.)). German(FRG) Patent 2,545,297/B/. 18 Aug 1977. 5p. (In German).

It is the purpose of the invention to achieve a reduction of heat losses in solar collectors by constructive measures. A wall material is proposed for cell structures. These cell should largely prevent thermal convection above the absorber plate, but the material of the cells must be transparent to light, and non-transparent for long wave infra red radiation. The wall material for the cell structures consists of a sheet in which material with the properties described above is inserted. The material may consist of: Glass, glass fibres, glass pellets, ground glass fibres, mineral powder, mineral pellets, broken mineral fibres or ground mineral fibres.

49829 **Liquid circuit system with stores, to generate heat, particularly from solar radiation.** Oberberger, J. German(FRG) Patent 2,604,361/A/. 18 Aug 1977. 5p. (In German).

The invention concerns a liquid circuit system for generating heat, particularly in connection with solar collectors: The heat energy gained in the collector is transported to a store which is situated at a higher level than the collector, so that the gravity can be used, and no circulating pump is required. A hose coloured black is used as collector. Transparent hoses can also be used. In this case the liquid is coloured black and a heat exchanger is interposed between collector and store.

49830 **Guide arrangement for the continuous adjustement of a solar collector.** Brantley, L.W.; Lawson, B.D. (to National Aeronautics and Space Administration, Washington, D.C. (USA)). German(FRG) Patent 2,702,297/A/. 18 Aug 1977. 11p. (In German).

The invention concerns a guide arrangement for the continuous adjustment of a solar collector. The arrangement consists of a largely equally bent shaft arranged to rotate parallel to the polar axis with spacing to the diametrally opposite sides. The shaft forms a supporting part between the outer ends of the bend lying transverse to the main axis, on which the solar collector is supported.

49831 **Folding pneumatic solar concentration mirror.** Kleinwaechter, J. German(FRG) Patent 2,604,345/A/. 11 Aug 1977. 7p. (In German).

The invention concerns a mirror for concentrating sunlight. The equipment consists of a torus which can be blown up and folded with two circular plastic sheets, one of which has a metallic mirror surface while the other is clearly transparent. Both sheets are connected as upper and lower cover so that the chamber so formed can have excess or lower pressure applied to it via a valve, and in both cases a converging lens of variable focal length is produced by spherical deformation.

49832 **Process and equipment for coverting solar energy into useful heat.** Seifried, W. (to Farbwerke Hoechst A.G., Frankfurt am Main (Germany, F.R.)). German(FRG) Patent 2,603,170/A/. 28 Jul 1977. 19p. (In German).

The process used for converting solar heat into useful heat is characterised by the fact that one lets the sun's rays act on a mixture of heat carrier and absorber particles, and transfers the energy taken from this mixture to a unit which consumes and/or stores energy. The solar collector used for carrying out the process is constructed from a container which contains a mixture of at least one heat carrier, which can be liquified, and absorber particles. The side of the container turned towards the sun is transparent. The transparent container surface is of such size that any absorber particles deposited if flow stops cannot be reached by the sun's rays penetrating the transparent covering. The danger of overheating of the collector is thus avoided. The absorber particles consist of a heat-conducting material which absorbs solar radiation, particularly in the infra-red range.

49833 Equipment for heating water by solar radiation. Pruefling, G. German(FRG) Patent 2,602,320/A/. 28 Jul 1977. 8p. (In German).

A black pipe consisting of flexible material, with water flowing through it which acts as absorber for solar radiation. The pipe is surrounded by a protecting pipe which permits light to pass through. The intermediate space between absorber and protective pipe is evacuated. The whole hose system is wound spirally in one plane. The back has a layer of reflecting material on it. Apart from this, the whole system is provided with a covering which is translucent to solar radiation.

49834 Solar collector with glass structure reducing convection and heat losses. Raetz, K. German(FRG) Patent 2,602,753/A/. 28 Jul 1977. 13p. (In German).

The collector consists of a flat box with a simple glass or plastic cover and a black, light-absorbing floor. A grid reducing convection and re-radiation is placed in the space between cover and floor, consisting of glass or plastic and highly transparent to sunlight, but not transparent for heat radiation. The grid can be covered with mirror surfaces, if the cover is provided with a layer of reflecting heat radiation. A number of proposals are made in the present additional patent for the whole collector, in order to reduce the collector losses by a large amount.

49835 Solar collector made of flexible wall units. Zechner, W. German(FRG) Patent 2,602,928/A/. 28 Jul 1977. 4p. (In German).

A solar collector is described, which consists of flexible wall units, which are first supported by the liquid or gaseous heat transport medium flowing through, so that the solar collector attains its final shape. The collector consists of a foil in the form of a hose which is welded or glued, so that stabilising guiding webs are formed. The whole collector is surrounded by an airtight heat insulating foil which permits radiation to pass through. This foil is welded to another black foil to absorb solar light. A heat exchanger or a heat pump can be used for heat exchange purposes. Finally the patent specification also covers a photo electric layer which is attached to the foil.

49836 Equipment for hot water production from solar radiation. Prechova, Z. German(FRG) Patent 2,558,767/A/. 7 Jul 1977. 8p. (In German).

The solar collector described consists of the usual blackened absorber plate with suitable equipment for removing thermal energy. The absorber is covered by a glass plate, and the back has thermal insulation. By using flaps fitted at the side of the collector box, the absorber can be covered if no energy conversion is required. The insides of these flaps are covered with mirrors and can be set by setting motors, so that additional solar radiation reaches the absorber. Also the whole collector unit can be made to follow the sun.

49837 Solar collector made of plastic tubes. Kromer, W. German(FRG) Patent 2,554,095/A/. 16 Jun 1977. 7p. (In German).

The claim refers to a solar collector made of plastic tubes. The heat is transmitted via water. The system is directly connected with the water conduit by means of a pressure reducing valve. The flow velocity of the water is regulated by a metering valve situated at the collector exit.

49838 Method for temperature-controlled water heating by means of solar energy. Stoll, G. (to Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). German(FRG) Patent 2,554,975/A/. 16 Jun 1977. 8p. (In German).

A method for the temperature-controlled heating of water by means of solar energy is described. The temperature difference is measured within a temperature transmitter, and used for regulating a circulation pump. The temperature transmitter is placed in the return pipe of a solar collector and forms one unit with the collector. The transmitter is designed in such a way that its output signal follows the intensity of the solar radiation falling in almost inertia-free.

49839 Flat solar energy collector. Reinhard, K. (to ERNO Raumfahrttechnik G.m.b.H., Bremen (Germany, F.R.)). German(FRG) Patent 2,555,015/A/. 16 Jun 1977. 8p. (In German).

The invention concerns a flat collector with an absorbing surface, which is connected to a pipework system for a heat transport medium, and which has a transparent covering plate. It is the purpose of the invention to reduce the heat losses arising between absorber plate and cover to a negligible value. This is achieved by having the cover plate and absorber plate connected to be vacuum tight at their edges, and evacuating the space between. The absorber plate and cover plate are mutually supported by poorly heat-conducting spacers. In another design, the absorber plate is inside a hollow space formed by two transparent windows, which is evacuated. The inside of the rear window and the back of the absorber plate can be covered with mirrors. Apart from this the space between can be designed with a super-insulation.

49840 Equipment for heating a liquid or gaseous heat carrier using solar radiation. German(FRG) Patent 2,555,229/A/. 16 Jun 1977. 16p. (In German).

A flat collector is described. The absorber consists of flexible material. Two material strips are glued or welded to form a chamber for the heat transport medium, so that cylindrical hollowed out spaces are created in several places, which extend over the whole length of the absorber and open into a common pipe at the upper and lower ends. To reduce heat losses, the flexible absorber plate is covered by a strip of material transparent to light, so that an air-filled intermediate space is formed, which can be blown up. Several covering strips can be used. The water introduced via a valve leaves the absorber in free flow.

49841 Flat plate collector and process for its operation. Justi, E.W. German(FRG) Patent 2,553,947/A/. 8 Jun 1977. 14p. (In German).

An improved flat plate collector is described. It is well known that the construction of the usual flat plate collectors has glass covers to reduce re-radiation by the absorber. The principle of the improvement of the efficiency consists in a cooling medium (e.g. water) flowing between 2 glass cover plates, which is heated a little. This heated water is introduced into the actual absorber. By this process, thermal stresses can also be avoided in the cover glasses. Also multiple reflection of light on the way to the absorber is avoided, if several cover glasses are available. This also entails an improvement of efficiency.

49842 Solar collector. Seifried, W. (to Farbwerke Hoechst A.G., Frankfurt am Main (Germany, F.R.)). German(FRG) Patent 2,554,243/A/. 8 Jun 1977. 21p. (In German).

The purpose of the invention is the creation of a solar collector which guarantees the optimum use of the radiation energy impinging on it, without requiring expensive constructional measures. The collector described consists of an absorber equipped with units which provide heat transfer and heat conduction, and a cover unit to cover the absorption surface. The equipment is characterised by the fact that a large number of converging lenses are arranged side by side on a support. A reflecting layer is arranged between the converging lenses and the absorption surface, which has gaps transparent to light, which are arranged so that the radiation focussed by the converging lenses can pass through. The length of focus of the lenses is selcted so that the plane in which they are focussed is the plane of the gaps. Finally, a process for manufacturing the collectors is described.

49843 Absorber element for solar collectors. German(FRG) Patent 2,548,619/A/. 12 May 1977. 10p. (In German).

The invention concerns an absorber element for solar collectors. With normal absorbers, it was discovered that the heat transfer liquid does not flow evenly through all the pipes, so that only part of the absorber surface is used to the optimum extent. According to the patent specification, a pipework system is created which is distinguished by the fact that equal flow resistance is guaranteed in all pipes. Constructional details are given.

49844 Physical fundamentals for the calculation of flat plate collectors. Pt. 6. Parametric variations of collector characteristic values. Bossel, U. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 3, 18-21, 24(May 1977). (In German).

The general collector equation which was presented in part V is interpreted in part VI (the last part in the series) with a view to application in practice. The main influencing parameters are varied in order to change the collector efficiency degree in dependence of other influencing factors. Calculations are made with the aid of a computer program. The following influencing factors were considered: Absorber layer, solar radiation, ambient temperature, wind velocity, selectivity of absorbers, no-load temperature of collector.

49845 Heat exchange equipment for using heat from solar radiation. Kloeckner, E. German(FRG) Patent 2,544,440/A/. 14 Apr 1977. 18p. (In German).

A normal flat plate collector for converting solar energy into heat energy is described. A flat heating body with parallel grooves, impressions or corrugations for guiding the heating medium flow, as used for steam and/or hot water heating, is used as absorber. The absorber is thermally insulated in the usual way and has a matt black layer on the surface, and a double glass cover is provided. The use of normal installation material makes the collector a particularly good value for the money.

HEAT STORAGE

REFER ALSO TO CITATION(S) 50363

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

REFER ALSO TO CITATION(S) 50522

49846 Project 'Dry-hot-rock' supplies energy from hot stones. *VDI (Ver. Dtsch. Ing.) Nachr.;* **32**: No. 4, 1(Jan 1978). (In German).

NON-USA

REFER ALSO TO CITATION(S) 49883

49847 Geothermal energy in Iceland. Elkington, J. (Terrestrial Environmental Studies, London). *New Sci.;* 439-441(16 Feb 1978).

The history and present trends of the use of the geothermal resources of Iceland are discussed. Space-heating and industrial uses have been steadily growing. Efficiency of usage will decrease with the gradual increase in electricity generation compared with those in heating and drying. Environmental problems connected with the use of geothermal energy are summarized briefly. (JGB)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

REFER ALSO TO CITATION(S) 51306

49848 Experimental study of two-phase hydrothermal convection in a porous medium with applications to geological problems. Sondergeld, C.H. Ithaca, NY; Cornell Univ. (1977). 115p. University Microfilms Order No. 78-02,066.

Thesis (Ph. D.).

Two-phase hydrothermal convection in a porous layer was studied experimentally using a sand box and a flow visualization tank. The observations are applied to natural geothermal systems and to problems in prophyry metal and mercury mineralization. Experiments were performed with glass beads and distilled water. The experiments consisted of uniformly heating a water saturated matrix along its base until boiling occurred. Convective fluid motions were detected using horizontal and vertical arrays of temperature sensors, water level fluctuations and photographs. The boundary conditions for the experiments were a permeable isothermal upper surface; adiabatic side walls; and uniform base temperature. Important experimental observations are summarized. A one-dimensional model for isothermal two-phase counterflow in porous media was developed to explain the observed steam heights. Observations during experiments of dye movement and the precipitation of dissolved copper sulfate were applied to mechanisms of porphyry ore deposition. Field observations were interpreted in terms of experimental observations. Copper sulfate experiments suggested that relative mineral solubilities in steam and water could play an important role in ore deposition in a boiling environment. It is also suggested that counterflowing convection in a two-phase system could provide an efficient means of transporting mercury and hydrogen sulfide. The mobility of Hg in aqueous solution is negligible without forming a complex. An examination of mercury mineralization in the western United States suggests a strong association of mercury deposits and natural two-phase systems. (JGB)

USA

49849 Recent fractures along the northeast margin of the Salton Trough, Imperial County, California. Buckley, C.P.; Magee, M.E.; Hayden, N.A. (California State Univ., Fullerton). *Calif. Geol.;* **30**: No. 3, 58-60(Mar 1977).

Ground fractures along the northeast margin of the Salton Trough near Dos Palmas Spring, Imperial Valley were investigated. The west-northwest-trending fracture zone measured 4 km in length with a maximum width of 135 meters. Both aerial and surface mapping methods were used in the investigation. Preliminary data indicate that the fractures are aseismic, tectonic in origin, and the product of tensional stress. (JGB)

49850 Geochronology and evolution of the Clear Lake volcanic field. Donnelly, J.M. Berkeley, CA; Univ. of California (1977). 52p. University Microfilms Order No. 77-31,336.

Thesis (Ph. D.).

The Clear Lake Volcanics cover approximately 400 km^2 in the northern California Coast Range. More than 60 potassium—argon dates helped to establish the range of ages from 2 million years to 10,000 years, of the lavas. The K—Ar dates were especially important for determining the ages of isolated units and sequences, and have been essential to understanding the evolution of the magmatic system in time and space. In a general way, the Clear Lake Volcanics get younger to the north, as do Tertiary volcanic rocks along the length of the California Coast Range. The dates have demonstrated the existence of at least two time breaks in the volcanic sequence, and have suggested two other time breaks. Analysis of the pattern of evolution resulted in some constraints on when volcanic activity might be expected, where it might occur, and what composition of lava might be expected, but questions remain as to the cause of the volcanic activity and the source of the magmatic liquids. The Clear Lake Volcanics lie adjacent to The Geysers steam field. Mapping of the volcanic rocks revealed an abundance of faults, some of which may be currently active. The K—Ar dates agree well with magnetic polarity determinations. Together, the dates and the magnetic polarities have identified at least 6 units which fall within the Jaramillo normal magnetic polarity event and suggest that the Jaramillo should be longer than its currently defined limits of 0.89 to 0.95 m.y. Although many units erupted in and near the Jaramillo, no eruptions occurred within 0.1 m.y. on either side of the 0.7 m.y. Brunhes-Matuyama magnetic polarity reversal. (JGB)

49851 Magma chamber of the Bishop Tuff: gradients in temperature, pressure, and composition. Hildreth, E.W. Berkeley, CA; Univ. of California (1977). 338p. University Microfilms Order No. 77-31,399.

Thesis (Ph. D.).

The Bishop Tuff in eastern California is a rhyolitic ash-flow complex erupted 0.7 m.y. ago concurrent with collapse of the 20 x 30 km. Long Valley caldera. The ash-fall and outflow sheets represent >170 km^3 of compositionally zoned magma, while a large additional intra-caldera volume is concealed by younger deposits. Eight major and several minor emplacement units vented rapidly enough that surficial reworking of overrun units is not recognizable and superimposed sheets cooled as a unit, except distally. Field, mineralogical, and chemical evidence agree that tapping of the thermally and chemically zoned chamber was continuous, without interruptions sufficient to allow mixing or phase re-equilibratin. Fe—Ti oxide equilibration temperatures for 68 glassy samples increase systematically from 720° to 790°C, corresponding well with the stratigraphic sequence but in no way with degree of welding. An enigma raised by the data concerns the range of depths tapped by the eruption. Internally consistent thermodynamic relations indicate a range of pressures from 0.7 to 4.5 kb (approximately 2 to >15 km), but the eruptive volume represents only a 1 km drawdown of the magma reservoir into which the cauldron-block subsided. Localized surging of deep-level magma, perhaps related to asymmetric roof collapse, might resolve the dilemma. The geologic and petrologic evidence is in good agreement that the chamber roof was quite shallow (2 to 5 km). A mechanism for generation of the compositional zonation is suggested whereby a high-silica liquid with the average elemental concentrations of the Bishop Tuff is first generated in the upper part of a high-level magma chamber of granodioritic bulk composition. (JGB)

NON-USA

49852 Geothermal activity of Iceland as a reflection of its geological structure. Kononov, V.I.; Polak, B.G. (Geological Inst., Moscow). *Tectonophysics;* **46**: No. 1/2, 135-157(4 Apr 1978).

In accordance with the task given to the Soviet Geodynamic Expedition and aimed at elucidation of the relationship of Iceland to the adjacent structures of the oceanic bottom, three forms of recent geothermal activity of Iceland have been studied: the background conductive heat flow, hydrothermal activity, and volcanism. It has been established that the thermal conductivity of basalts in Iceland is, on an average, 3.62×10^{-3} cal/cm . sec . °C. The geothermal field abounds in local anomalies caused by the circulation of hydrothermae. In their gas composition, the thermal fluids are divided into nitrogenous, carbon-dioxide, nitrogen--carbon-dioxide, and hydrogenous. The latter, being representative of the hydrothermal activity of Iceland, are the most powerful high-temperature hydrothermal systems associated with the Median zone. The distribution of geochemical types of fluids is subject to a well-pronounced zonation coinciding with the geostructural pattern of the island and zonation of the heat effect of hydrothermal discharge. The heat power of nitrogen--carbon-dioxide and hydrogenous thermae shows the participation of deep heat-carriers in their formation. The effect of hydrothermal activity in the Median zone varies within 1.5 and 5.0 HFU. The isotopic contents of He, Ar, and S contained in thermal fluids confirms the presence of mantle emanations in them (the $^3He/^4He$ ratio reaches 3.3×10^{-5}, delta $^{40}Ar = 12\%$, delta ^{34}S approximately equal to 0‰) and testifies to difference of the Icelandic crust from the continental crust in composition. Individual volcanic centres are characterized by powers of the order of $n \times 10^8$ cal/sec, the fluctuations in which coincide with changes of the character of the productivity. The total energetic effect of Quaternary volcanism in

the Median zone is at the level of 3 to 5 HFU, with variations in place and time, however, of up to 8 HFU. (JGB)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 49852

49853 Geothermal anomalies along the Rio Grande rift in New Mexico. Reiter, M.; Shearer, C.; Edwards, C.L. (New Mexico Bureau of Mines and Mineral Resources, Socorro). *Geology;* 6: No. 2, 85-88(Feb 1978).

Heat-flow data suggest that there are regions along the Rio Grande rift where crustal temperatures are above those in neighboring areas. Magma bodies at 15 to 30 km, as predicted by several investigators, seem to provide reasonable sources of heat that could increase heat-flow values from 1.8 to about 2.5 HFU and somewhat higher. However, heat-flow values of 6.0 to 16.0 HFU occur at four locations along the Rio Grande rift; these values occur within geologic environments such as recent volcanic centers and the intersections of cauldron boundaries with large normal faults where upward heat transported by magmatic and/or ground-water movement is plausible. Test drillings of several kilometers are necessary to confirm the continuity with depth of these very high geothermal gradients and to relate them to their possible sources in the upper crust.

49854 Remote sensing applications in hydro-geothermal exploration of the northern basin and range province. Hodler, T.W. Corvallis, OR; Oregon State Univ. (1977). 235p. University Microfilms Order No. 77-29,413.

Thesis (Ph. D.).

A program of remote sensing overflights with ground truth teams was initiated in order to evaluate the effectiveness of remote sensing applications to geothermal resource reconnaissance in the northern section of the Basin and Range physiographic province. This area included parts of south central Oregon and northeastern California. The evaluation of geothermal potential was conducted utilizing side-looking-airborne-radar (SLAR) and thermal infrared (TIR) detectors in a complementary fashion. Although the remote sensing survey of surface hydrogeothermal sites failed to show heat potential for near surface direct electrical production, the thermo-structural relationship mapped may serve along with other geophysical techniques to direct subsurface exploration of the resource. Structural lineaments and hydro-geothermal source locations can be determined through the complementary use of SLAR and TIR. Once potential locations are determined, limited ground truthing would be required to verify the remotely sensed data. Such a reconnaissance tool may be of greatest value in a less developed area with similar geologic structure and geothermal promise. (JGB)

GEOCHEMICAL TECHNIQUES AND SURVEYS

49855 (LBL—7025) **Definition of engineering development and research problems relating to the use of geothermal fluids for electric power generation and nonelectric heating.** Apps, J.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1977. Contract W-7405-ENG-48. 63p. Dep. NTIS, PC A04/MF A01.

The use of geothermal fluids for electric power generation and nonelectric purposes causes problems not normally encountered when pure water is used for similar purposes. These problems must be identified and means developed to overcome them before geothermal energy resources can become an important source of electric power or thermal energy in the United States. Research and development projects aimed at solving problems arising from the use of geothermal fluids from known sources in the United States are listed. Problem areas covered are: impact on engineering design caused by chemical, thermodynamic, and transport properties of geothermal fluids; scaling and sludge formation; gases, volatile brine constituents, condensate chemistry; environmental problems. The research projects identified are general in nature and are not site specific. (JGB)

49856 Microcomponents of Paratunka (Kamchatka) thermal waters determined by instrumental neutron activation analysis. Menyaylov, A.A. *Int. Geol. Rev.;* 19: No. 12, 1415-1420(Dec 1977).

Translated from Geologiya i Razvedka: No. 2, 81-87(1976).

Data on microcomponents of thermal waters of the Paratunka reservoir obtained by instrumental neutron activation analysis (INAA) are discussed. Subjected to analysis were waters from four boreholes through the reservoir, of which one (TW-4) belonged to the Lower Paratunka, two (TW-5 and TW-7) to the Middle Paratunka, and one (TW-6) to the Karymshchina thermal fields. Analyses of waters from three springs of Iceland performed by an identical method are also given for comparison. Elements determined in the thermal waters are: Sc, Cr, Fe, Co, Zn, Se, Br, Sr, Rb, Zr, Cd, Sb, Ba, Te, Cs, La, Ce, Eu, Sm, Hf, Ta, Hg, and Th. (JGB)

EXPLORATORY DRILLING AND WELL LOGGING

49857 (LA—7224T) **Experimental permeability studies at elevated temperature and pressure of granitic rocks.** Potter, J.M. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 109p. Dep. NTIS, PC A06/MF A01.

Permeability of quartz monzonite from the Los Alamos hot-dry-rock geothermal well GT-2 was experimentally measured as a function of pressure and temperature. Permeability of the GT-2 rocks from depths of 8580 ft and 9522 ft behaves like Westerly granite for changes in effective confining pressure. However, permeability of these rocks behaves much differently with increasing temperature. As temperature is increased, the permeability of Westerly granite passes through a slight minimum and then increases exponentially above 100°C. Upon cooling the permeability shows a permanent increase of up to four times its original value. The permeability of GT-2-9522′, on the other hand, drops off exponentially with increasing temperature, reaching a minimum near 140°C; above 150°C, permeability rises slowly. These changes in permeability with temperature are postulated to be caused by differential thermal expansion (DTE), a phenomena related to the anisotropic and inhomogeneous coefficients of thermal expansion of the mineral grains in the rock. Scanning electron photomicrographs of unheated and heated samples of Westerly and GT-2 rocks support the DTE hypothesis. Differences in the behavior of these rocks with temperature are believed to be due to the respective temperature and pressure environments in which they became equilibrated, since both GT-2 rocks had existed at moderately high temperatures and pressures for some time. Temperature disequilibrium of the GT-2 rocks in their present in situ environments is believed to have caused the differences in the behavior between the two samples and may provide a method for determining the pre-intrusion geothermal gradient of the Jemez area. Flow channels were observed in GT-2 samples using radioactive tracer techniques. Several radioactive isotopes were tried in these experiments, including ^{22}Na, ^{63}Ni, and ^{35}S.

49858 Borehole geophysics evaluation of the Raft River geothermal reservoir. Applegate, J.K.; Donaldson, P.R.; Kinkley, D.L.; Wallace, T.L. Tulsa, OK; Society of Exploration Geophysicists (1976). 34p.

Borehole geophysics techniques were used in evaluating the Raft River geothermal reservoir to establish a viable model for the system. The assumed model for the hot water (145°C) reservoir was a zone of higher conductivity, increased porosity, decreased density, and lower sonic velocity. It was believed that the long term contact with the hot water would cause alteration producing these effects. With this model in mind, cross-plots of the above parameters were made to attempt to delineate the reservoir. It appears that the most meaningful data include smoothed and expanded plots of transit time, porosity, and density as a function of depth; and triangular plots of transit time, porosity, and density. This data yields discrete zones which appear to be the productive zones.

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 49860

49859 (PSR—705) **Site-specific analysis of hybrid geothermal/fossil power plants.** Anno, G.H.; Dore, M.A.; Grijalva, R.L.; Lang, G.D.; Thomas, F.J. (Pacific Sierra Research Corp., Santa Monica, Calif. (USA)). Apr 1977. 147p. Dep. NTIS, PC A07/MF A01.

The results of an analytical effort to determine the cost effectiveness of hybrid geothermal/fossil-fuel electrical-power generating stations. The analysis is directed at combining hydrothermal and coal energy in a Rankine steam cycle, for electrical power generation for the City of Burbank, California. This effort develops a methodology for hybrid power-plant cost analysis so that preliminary plant designs can be optimized as a function of specific site conditions and characteristics. It also defines cost-optimized site-specific plant designs for four potential sites: Roosevelt Hot Springs, Utah, Coso Thermal Area, California, East Mesa, California, and Long Valley, California. These optimized designs are compared for the costs, geothermal-resource utilization, and fossil fuel saved. The results indicate that development of geothermal resources to support a hybrid power plant are favorable for at least two of the four sites.

GEOTHERMAL POWER PLANTS

DESIGN AND OPERATION

49860 (SAN—1124-2) **Advanced design and economic considerations for commercial geothermal power plants at Heber and Niland, California. Final report.** (Bechtel Corp., San Francisco, Calif. (USA)). Oct 1977. Contract EY-76-C-03-1124. 199p. Dep. NTIS, PC A09/MF A01.

Two separate studies, involving advanced design and economic considerations for commercial geothermal power plants using liquid-dominated hydrothermal resources, are presented. In the first study, the effects on design, capital cost, and bus bar electric energy production cost caused by an anticipated decline in available geothermal fluid temperature over the lifetime of power plants are described. A two-stage, flashed-steam energy conversion process was used for the conceptual design of the power plants, which operate from the moderate-temperature, low-salinity reservoir at Heber, California. Plants with net capacities of 50, 100, and 200 MWe (net) were investigated. The results show that it is important to include provision for geothermal fluid temperature decline in the design of power plants to prevent loss of electric energy production capability and to reduce bus bar electric energy costs. In the second study, the technical, economic, and environmental effects of adding regeneration to a 50 MWe (net) power plant employing the multistage-flash/binary process are described. Regeneration is potentially attractive because it recovers waste heat from the turbine exhaust and uses it in the power cycle. However, the pressure drop caused by the introduction of the regenerator decreases the turbine expansion and thus decreases system performance. An innovative approach was taken in the design of the regenerator, which minimized the expected performance degradation of the turbine. The result was that the performance, capital cost, and bus bar electric energy production cost are nearly the same for the processes with and without regeneration. On the other hand, the addition of regeneration has the environmental benefits of substantially reducing heat rejection to the atmosphere and cooling tower makeup and blowdown water requirements. It also increases the temperature of the brine returned to the field for reinjection.

GEOTHERMAL ENGINEERING

49861 **Automatically submersible vessel with telescope vessel and additional, inside-positioned, controlled heating element for gaining geothermal energy.** German(FRG) Patent 2,605,747/A/. 18 Aug 1977. 5p. (In German).

While the vessel, according to the main patent P 2517919 is divided into water room, steam room, and superheater room, which makes it a steam generator, it is fitted in the additional patent claim with platen walls staggered in the longitudinal axis between the outer and inner tube of the hollow cylinder, and is to be charged with air, pure nitrogen or other gaseous media. These gaseous media are to pass along all the inner walls of the vessel and are to be heated as much as is possible; then they are to rise through a tube to the steam generator above ground. After that they are led downwards again in a continuous cycle via a compressor.

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 50962

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 49855

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

49862 (SAND—78-7052) **Analysis of water reinjection at the Niland Geothermal Test Site.** Jorda, R.M. (Completion Technology Co., Houston, Tex. (USA)). May 1978. Contract EY-76-C-04-0789. 90p. Dep. NTIS, PC A05/MF A01.

The problems associated with reinjecting spent geothermal brines are currently under investigation. This effort has included field tests of injection water to evaluate treating equipment effectiveness at the Niland Geothermal Test Loop. Membrane filter tests were conducted on fluids from the settling tanks, from the test loop, from the clarifier and at the injection well head (Magmamax No. 3). From this and other information concerning the injection interval, pressure, temperature and well history, an attempt to predict a well half life was made. The results of these calculations were not in agreement with observed well performance. An attempt with some apparent success has been made to understand the possible source of these discrepancies. The cyclic nature of the injection history dictated by need for descaling the test loop, followed by apparent partial recovery of injection acceptance, has led to a theory that is under investigation concerning effect of reheating the injection fluid containing amorphous particulate silica by the reservoir rock and fluid during well shut-in. Preliminary tests indicate some of this finely divided silica may be redisolving with consequent reduction in reservoir damage, and that two widely spaced injection wells in an alternating mode may provide low-cost, long-life injection capacity at Niland and similar geothermal projects.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

49863 (LA—7235-MS) **Thermal stress cracking and the enhancement of heat extraction from fractured geothermal reservoirs.** Murphy, H.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

Given sufficient time, the extraction of heat from geothermal reservoirs formed by the hydraulic fracturing of competent rock will eventually result in the formation of thermal stress cracks in the reservoir. These cracks penetrate the rock in a manner such that the penetration-to-spacing ratio is approximately one. The penetration depends upon the extent of cooling and the square root of time. Initially then, the cracks are closely spaced and penetrate but little, so that a crazing pattern is apparent; but with increasing time some of these cracks, now more widely spaced, grow deeper. Eventually these larger cracks attain a critical aperture such that significant rates of water flow can be established within them and thus the newly created heat transfer area becomes useful for heat extraction. At the same time that cracks are forming within the main reservoir, thermal cracking also occurs in the wellbores that communicate with the reservoir. These cracks eventually convey water to and from the reservoir, thus leading to a decrease in the flow impedances that are often concentrated in the wellbore regions.

49864 **Power from hot rocks.** Newell, J. *Coal, Gold Base Miner. South. Afr.;* **26**: No. 4, 65(Apr 1978).

A likely key to the really large scale exploitation of "hot rock" power has been found. A technique has been developed for fracturing hard granite rocks, like those of Cornwall in the Southwest of England, so thoroughly that water poured down boreholes is heated to high temperatures before being pumped back to the surface. The technique creates such dense cracking that the water flows through many more channels and so spends more time in contact with the hot rocks than has previously been possible. Water containing solvents is pumped down through boreholes into rocks containing ore, the solvents dissolve the minerals out of the rocks, and the water brings them up to the surface where they can be chemically precipitated out of solution. By detonating a small explosive charge of very precisely calculated power at the bottom of a borehole, small cracks can be formed extending from top to bottom of the hole and radiating out for short distances, like the spokes of a wheel seen from above. The cracks can be greatly extended by blocking the top of the borehole and pumping in water or some other liquid, perhaps containing lubricating polymers, under very high pressure. The liquid then acts as an hydraulic wedge, widening and lengthening the cracks enormously. If several boreholes are drilled fairly close together and treated in this fashion, then the cracks spreading from each will meet and form a continuous dense network of fissures, ideal for leaching out metals or heating water. (JGB)

DIRECT ENERGY UTILIZATION

49865 (SAN—1319-1) **Geothermal absorption refrigeration for food processing industries. Final report, December 13, 1976—November 13, 1977.** Harris, R.L.; Olson, G.K.; Mah, C.S.; Bujalski, J.H. (Aerojet Energy Conversion Co., Sacramento, Calif. (USA)). Nov 1977. Contract EY-76-C-03-1319. 186p. Dep. NTIS, PC A09/MF A01.

The first step in the economic analysis of the integration of geothermally powered absorption refrigeration into a food processing plant was an evaluation of the potential geothermal sites in the Western United States. The evaluation covered availability of raw materials, transportation, adequate geothermal source, labor, and other requirements for food processing plants. Several attractive geothermal sites were identified--Raft River, Idaho; Sespe Hot Springs, California; Vale Hot Springs, Oregon; Weisler-Crane Creek, Idaho; Cosco Hot Springs, California; and the Imperial Valley, California. The most economically attractive food processing industry was then matched to the site based on its particular energy, raw material, and transportation requirements. The more promising food processors identified were for frozen potato or vegetable products, freeze-dried products, and meat processing. For the refrigeration temperature range of +32°F to -40°F and geothermal temperature range of 212°F to 300°F, an absorption refrigeration system had to be identified, designed, and evaluated. Both the

conventional ammonia/water and an organic absorption refrigeration system using monochlorodifluoromethane (R-22) as the refrigerant and dimethyl formamide (DMF) as the absorbent were studied. In general, only a 60°F to 100°F temperature drop would be effectively used for refrigeration leaving the remainder of the allowable temperature drop available for other use. The economic evaluation of the geothermal system installed in a food processing plant required the comparison of several principal alternatives. These alternatives were evaluated for three different food processing plants located at their optimum geothermal site: a forzen potato product processing plant located at Raft River, Idaho; a freeze-dried product plant located at Sespe Hot Springs, California; a beef slaughter operation located in the Imperial Valley of California. (JGB)

49866 Method for using geothermal energy. Gill, G.H. US Patent 4,085,795. 25 Apr 1978. Filed date 10 May 1976. 4p.

Geothermal energy is used to provide the temperatures and pressure necessary for catalytic conversion of carbon monoxide and hydrogen to methanol by lowering the reaction chamber into a geothermal well or by otherwise using geothermal fluids to supply heat and pressure to the reaction chamber.

GEOTHERMAL DATA AND THEORY

49867 Dynamics of bubble formation and growth in magmas: a review and analysis. Sparks, R.S.J. (Univ. of Lancaster, Eng.). *J. Volcanol. Geotherm. Res.;* 3: No. 1/2, 1-37(Mar 1978).

The mechanisms of bubble formation and the dynamics of bubble growth in common magmas were investigated. Experimental and theoretical data suggest that the levels of volatile supersaturation pressure required for nucleation are low (less than 10 bars) due to the occurrence of surface active components in common magmas. The growth history is, moreover, insensitive to the assumptions made on nucleation, except during early stages of growth. Nucleation theory indicates that there is a minimum diameter of bubble that can be preserved in tephra which is of the order of a few microns. A numerical method was developed to determine bubble growth rates during volcanic eruptions of basaltic and rhyolitic magmas. It is proposed that most bubbles cease growth well before explosive disruption of the magmatic froth. This is postulated to occur at volume ratios of gas bubbles to liquid of the order 3:1 to 5:1. At this stage bubbles cannot expand further because of the increasing viscosity of the melt as exsolution takes place and because high viscosity liquid has to be forced along very thin paths between closely spaced neighboring bubbles. Vesicle walls are sufficiently thin that pressures close to equilibrium between gas bubble pressure and the vapor pressure of the gas dissolved in the liquid are established before the magma is disrupted. Equilibrium partitioning of gas between vesicles and liquid produces gas pressures of tens to hundreds of bars. The disruption of the magma is proposed to occur by bursting of the larger bubbles within the froth at the free surface of the magma due to a pressure difference across this interface.

PROPERTIES OF AQUEOUS SOLUTIONS

REFER ALSO TO CITATION(S) 50765

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 49857, 50764, 51327

ROCK-WATER-GAS INTERACTIONS

REFER ALSO TO CITATION(S) 51305

49868 Opaque mineral alteration states correlated with temperature in an active geothermal system. Abdel-Aal, O.Y.; Hall, J.M. (Dalhousie Univ., Halifax, Nova Scotia). *Nature (London);* 272: 239-240(16 Mar 1978).

Results of investigations of alterations of titanomagnetite and ilmenite from drill holes in the lower flank of the active volcano Agua de Pau, San Miguel, Azores, are reported. Bottom hole temperatures were measured during and after drilling and exceeded 200°C from 500m to 900m depth. Examination of 232 polished sections representing the lava flows and explosive rock types of the drill hole section showed that a wide range of degrees of hydrothermal alteration is present. The alteration states of titanomagnetite and ilmenite were identified microscopically and the chemical compositions were determined using an electron probe microanalyser. The correlation between the average measured and calculated temperatures and the titanomagnetite and ilmenite alteration states are given. (JGB)

49869 Phase and structural transformations of feldspars under hydrothermal conditions. Kotov, N.V.; Ryumin, A.A.; Frank-Kamenetskiy, V.A. *Int. Geol. Rev.;* 19: No. 12, 1369-1380(Dec 1977).

Translated from Vses. Mineralog. Obshch. Zapiski; 105: No. 6, 648-662(1976).

Hydrothermal treatment of albite, labradorite, and orthoclase in mixtures with dolomite revealed that at P/sub H_2O/ = 1000 kg/cm² and a residence time of 24 to 72 hr at T = 200 to 400°C, mainly calcite and trioctahedral layered silicates are formed. At 300 to 500° the following formation sequence was observed: montmorillonite → (Mg, Al) serpentine → chlorite from plagioclases and montmorillonite → a disordered mixed-layer phase of the mica-montmorillonite type → phlogopite from orthoclase. At 500 to 600° there is a tendency for formation of framework aluminosilicates (nepheline, kalsilite) at high Na and K concentrations in the initial mixtures, and nesosilicates (monticellite, forsterite) at high Ca and Mg concentrations. It is shown that as the residence time is increased synthetic and natural montmorillonites with Al/sup IV/ are not converted to ordered 1:1 mixed-layer phases, in contrast to those observed in systems with kaolinite. This is probably due to the statistically uniform distribution of Al in a structure of beidellite-type montmorillonites synthesized from feldspars, whereas beidellites with polar distribution of Al/sup IV/ over the (Si, Al-O) tetrahedral networks are apparently developed from kaolinite. When the albite structure is converted to the pyroxene structure, a considerable part of the tetrahedra is inherited by the latter; this follows from retention of the values of the chemical shift and quadrupole splitting typical of tetrahedral ^{57}Fe(III). The experimental data can be used to reconstruct the primary mineral composition of metamorphic pararocks.

49870 Stability of analcime and activity of H_2O in the system $NaAlSi_2O_6$-H_2O-CO_2. Likhoydov, G.G.; Ivanov, I.P.; Shmulovich, K.I. *Int. Geol. Rev.;* 19: No. 12, 1381-1390(Dec 1977).

Translated from Izvestiya, ser. geol.: No. 8, 46-57(1976).

Results of an analysis of mineral-forming media (from inclusions in the minerals) unambiguously show the virtually ubiquitous occurrence of CO_2 as the most important component of natural fluids after water. The dependence of the equilibrium temperatures of the reaction of analcime dehydration on the fluid composition was assessed over the wide range of pressures present in the earth's crust. The experimental data obtained made it possible to assess the dependence of the activity of water on its concentration in the fluid at 450 to 600°C and at pressures from 0.98 to 5.88 kbar. (JGB)

TIDAL POWER

TIDAL POWER PLANTS

REFER ALSO TO CITATION(S) 49883

WAVE ENERGY CONVERTERS

49871 Wave energy generator. Hellwig, F. German(FRG) Patent 2,606,107/A/. 18 Aug 1977. 3p. (In German).

The application concerns in principle the utilization of the energy of sea waves for generating electric power. A floating body only vertically movable, is moved up and down by the waves, puts into action via a lever arrangement in a mechanical, hydraulic or pneumatic way a big weight rotating around a vertically arranged driving shaft, the shaft operating a generator for power generation.

49872 Method and equipment to produce electrical energy from the wave motion of the sea. Ricafranca, R.M.; Donato, A.S. German(FRG) Patent 2,507,330/A/. 21 Aug 1975. 9p. (In German).

The described method to produce electrical energy from the wave motion of the sea is characterized in that the lifting movement of a sea wave within a pipe-shaped body connected with the sea is converted into a movement of the air column at the other end of the latter. Air is thus blown out or sucked in. A double acting turbine placed in this air current is made to turn. A generator coupled to the turbine then produces electrical energy. The amplitude of the sea waves can be increased by a converging inlet channel.

WIND ENERGY

AVAILABILITY (CLIMATOLOGY)

49873 Chances of wind power. Huetter, U. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 3, 3-8(May 1977). (In German).

The article presents a survey of the possibilities to use wind power in Western Europe, in particular in the FRG. On the basis of meteorologically given facts, Western Europe has a wind power potential of some 6 x 10^3 TWh/a; that of the FRG amounts to 220 TWh/a, which represents about 70% of the electric power used in 1973. On a medium-term basis (i.e. until 1990), wind power plants could mean a noticeable relief for public utilities. Concepts of wind power plants are discussed. In this context, a compromise between plant capacity and wind availability is to be considered. Finally, the costs of plants of this kind are discussed.

49874 Wind power research. Ziegler, A. (Bundesministerium fuer Forschung und Technologie, Bonn-Bad Godesberg (Germany, F.R.)). *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 3, 8-12(May 1977). (In German).

On the basis of the meteorological conditions a survey is presented of the regions in the FRG, which are suitable for wind power utilization. However, in order to determine the potential technically feasible, it has to be decided first with which type of plant wind power is to be converted into electric power. Of all the concepts proposed so far, the 'Huetter' concept seems to be the most promising at the moment. In order to make a substantial contribution to the energy supply, about 400 wind power plants with a capacity of 3 MW each would have to be taken into operation by 1985, something which cannot be achieved at the present state of the manufacturing capacities. Unsolved problems of wind power conversion are investigated by a number of research groups at the moment. The various projects are listed in tabular form.

49875 Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977). 496p. (CONF-760909—). $48.00.

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

Separate abstracts are presented for 26 papers on wind power availability and wind turbine systems. Ten papers were processed previously for the data base.

49876 Study on the use of windmills in Singapore. Nathan, G.K.; Rajasooria, G.P.D. (Univ. of Singapore). pp A5.75-A5.88 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The purpose of this study is to investigate the prospect of using wind power in the numerous islands in the region of Singapore and to design a suitable windmill. The wind data furnished by the Meteorological Services of Singapore for the mainland and the Port of Singapore Authority for the off-shore islands are analyzed. The analysis of wind data is based on hourly mean speed and a statistical analysis of the data is reported. Also, overall estimate of the total and the distribution pattern of available energy is made. A new concept is proposed to design windmills and experimental studies have been conducted in the wind tunnel to verify the effectiveness of the design method. Also, the feasibility of approximating the "ideal" blade design by flexible "sailwing" type blade is investigated. Results of the studies are reported.

49877 Wind energy research in New Zealand. Lindley, D. (Univ. of Canterbury, Christchurch, N.Z.). pp X10-X19 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Though there has been a long standing interest by the New Zealand Meteorological service in the structure of the wind over New Zealand and a working interest by the Universities of Auckland and Canterbury and the Ministry of Works in wind modelling of structures, it wasn't until two years ago that a coordinated wind energy research program was established. At that time the New Zealand Energy Research and Development Committee (NZERDC) was formed under the chairmanship of Dr. C.J. Maiden, to coordinate Energy Research and Development. Of the $918,000 expended so far, approximately 10% has gone to support wind energy research.

49878 Low cost recorder for a wind energy survey. Edwards, P.J. (Otago Univ., Dunedin, N.Z.). pp X20-X21 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

An observational program for a wind energy survey is being carried out in several areas of New Zealand. The instrumentation required, excluding the anemometer assembly, was developed locally. Wind-run, or mean wind speed, is obtained by counting one pulse per revolution of the anemometer on a modified pocket calculator. Mean wind speeds are recorded electronically on standard two-channel reel-to-reel or cassette tape decks. A frequency proportional to the wind speed is recorded on channel one and a clock pulse train on channel two. Mean wind speeds over time intervals as short as three to five seconds or as long as one month can be retrieved.

ECONOMICS

REFER ALSO TO CITATION(S) 49905, 50506

49879 Potential for power production by large dispersed arrays of wind turbines. Justus, C.G. (Georgia Inst. of Tech., Atlanta). pp A2.23-A2.38 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The performance characteristics have been simulated for large dispersed arrays of 500 kW to 1500 kW wind turbines producing power and feeding it directly into the New England (U.S.) utility distribution grid. These studies show that in moderate-to-good wind environments the 500 kW generators can average (on an annual basis) 190 to 240 kW mean power output, and the 1500 kW generators (which must have higher winds to operate at full capacity) can average 240 to 340 kW mean power output. The beneficial effect of operating large disperse arrays of wind turbines is that reliable power output can be increased--if winds are not blowing over one part of the array, chances are they will over some other part of the array. These studies indicate that 100 kW per 500 kW generator can be achieved with about 70% to 85% reliability (depending on season) with no storage involved, by spreading the wind turbines over a disperse grid of about 500 km size.

49880 Economics of a vertical-axis wind turbine. Fritzsche, A.A. (Dornier-System G.m.b.H., Friedrichshaften, Ger.). pp D1.1-D1.6 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Some economic aspects of the vertical-axis wind turbine (Darrieus type) are considered. A summary of the various kinds of application is presented. The components of the turbine consists of conventional and new developed ones. The manufacturing processes of the rotor blades and the rotating tower depend on the size of the unit to a far extent. It is proved by a cost estimate that the manufacturing costs are highly influenced by labor cost. Splitting up of the total unit in individual components facilitates a less complex manufacture of all components with high labor rate in developing countries. Based on the present stage of technical development, manufacturing costs of the vertical-axis turbine are to be expected in the same order of magnitude as the commercially available wind turbine with horizontal-axis (10 kW). In a power range above 20 kW it can be assumed that the Darrieus rotor will be less economic.

49881 Self-contained 5,000 kW capacity wind energy conversion system with storage. Fekete, G.I. (McGill Univ., Montreal). pp F2.13-F2.29 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The use of wind energy as the sole source of generating 5,000 kW-s of continuous electrical power is considered for the Magdalen Islands. The system is to be self-contained and it is required that it can be built within the next few years using, by then, known technology. The wind environment of the Magdalen Islands is found to be ideal for wind energy conversion systems. Performance calculations are carried out for two systems which are technically feasible. A constant load demand combined with the variation in the available wind energy leads to large variation in the generator load factor, and to extensive storage capacity requirements. The capital cost of the two systems and the cost of electricity are established to first order. The minimum capital cost is of the order of $65 x 10^6, and the

minimum cost of electricity can be expected to be of the order of 20 cents/kW-hr. Almost half of this cost is due to the energy storage feature of the system.

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 49790, 49877

49882 Wind energy techniques once and now. Stampa, U. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 3, 12-15(May 1977). (In German).

The article is arranged in two parts. The first part deals with the history of the windmills. Various types of windmills are described. The second part is concerned with modern wind power plants. The advantages and disadvantages of the various systems are discussed. Finally, economic aspects of wind power plants are dealt with.

APPLICATIONS

49883 Alternative energy sources in the USSR. Gruenbaum, R. (Royal Swedish Academy of Engineering Sciences, Stockholm). *Ambio;* 7: No. 2, 49-55(1978).

Alternative energy sources, like wind, solar, and geothermal energy, are being considered in the Soviet Union mainly for solving local energy supply problems, particularly in the sparsely populated regions of Central Asia, Siberia, the Far North, and the Far East. Whereas providing conventional forms of energy for space heating and cooling, and for the generation of electricity in these fringe areas is often expensive and complicated, favorable conditions exist for the exploitation of alternative sources of energy. Equipment based on wind and solar energy is being developed chiefly for use in agriculture and livestock breeding. Geothermal energy will be utilized for heating buildings and hot-houses, and tidal energy is being developed for large-scale electricity production.

49884 Wind power installations for water pumping in developing countries. Parkes, M.E. (Univ. of Newcastle-upon-Tyne, Eng.); van de Laak, F.J.M. pp F3.31-F3.40 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

In developing countries windmills may be used for pumping in rural water supplies, smallholder irrigation or cattle watering. Possible applications are examined by considering wind power potential and design criteria in one such country, Tanzania. Wind rotors and associated pumps are reviewed with reference to low cost irrigation purposes. A technique is presented for assessing the minimum storage requirements to provide uniform water supplies from wind-powered installations. An economic comparison of wind and engine-powered water supplies is given.

49885 Performance-optimised wind energy conversion system for space heating. Freris, L.L. (Imperial Coll. of Science and Tech., London). pp X60-X62 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The objective of this project is to set up and demonstrate a small size wind energy conversion system that is cheap to manufacture and can provide energy at competitive cost in comparison to other fuels. For the economics to be favorable, it is necessary to satisfy the following conditions: (1) The energy converted should be utilized in such a way that the minimum complication and cost is incurred. (2) A cheap energy storage device is used. (3) The windmill rotor should operate at maximum conversion efficiency irrespective of wind speed changes and the level of utilization of its output should be as high as possible. The above conditions are satisfied if the wind energy is wholly utilized for the space heating of buildings and greenhouses. In a household, space and water heating represent about 80% of the yearly energy demand, space heating in northern climates being necessary for ten months of the year and water heating demand being continuous. With the windmill coupled to an alternator the output of which is used directly to generate heat in a dissipative load, immediate use is made of the available wind energy. With such an application there is no need to control the frequency of the alternator. This simplifies the electrical system and permits the use of simple controllers to maximize the power extracted from the wind.

49886 Use of thermal storage. Todd, R.W. pp X73-X74 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The use of wind power for generating heat for space heating through hydraulic resistance is described. The use of wind power for electric resistance heating and heated water storage system is also described.

49887 Some windpower developments in Kenya. Hilton, D.J. (Univ. of Nairobi, Kenya). pp X75-X76 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Reliable wind resources in Kenya are to be found mainly in two areas, namely the flat, arid North Eastern Region and in the west around Lake Victoria. It has been found that the winds in these areas are more useful than was formerly thought. The reason for this is that previous wind data in these areas was sparse and consisted mainly of day-time Beaufort estimates. In areas where large trees are absent this led to an underestimation of wind velocity and completely ignored night winds, which particularly in the North-East can be very strong. Conventional water-pumping mills of the multi-blade type have been used in Kenya in the past but mainly in the high-potential farming areas where the wind was not particularly reliable. With very few exceptions they were not employed in those areas of greatest wind potential. Attention is now being given, however, to the use of windpumps for small scale irrigation and in the ranching areas for watering cattle. A third common application is seen as pumping water from an earth dam or well through a sand filter for human consumption.

49888 Underground gas storage in the United States, and its potential application to wind-powered systems. Eldridge, F.R. (Mitre Corp., McLean, VA). pp X77-X79 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

It is seen that gas turbine systems that use wind power for compressing air, which is, in turn, stored in high-capacity, natural underground reservoirs, offer the possibility for not only low-cost, short-duration energy storage, such as for "changeover buffer storage" where the purpose is to provide energy during the time required to shift between WECS and a conventional electric power system, in a fuel-saver mode of operation, or for "diurnal load smoothing storage" where the purpose is to provide additional energy to meet the diurnal load during periods of peak demand.

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 49875, 49876

49889 (DOE/NASA—9404-76/2) **Design study of wind turbines 50 kW to 3000 kW for electric utility applications: analysis and design.** (Kaman Aerospace Corp., Bloomfield, Conn. (USA)). Feb 1976. Contract EX-76-A-29-1010. 567p. (NASA-CR—134937; R—1382). Dep. NTIS, PC A24/MF A01.

The objective of the contract was to develop optimized preliminary designs of low power (50 to 500 KW) and high power (500 to 3000 KW) Wind Generator Systems (WGS) for electric utility applications. The low power system is designed for a utility site with a yearly median wind speed of 5.4 m/sec (12 mph) and the high power WGS is designed for a utility site with an 8 m/sec (18 mph) median wind speed. The preliminary designs prepared in the study are intended to provide the bases for follow-on programs which will involve the detail design, fabrication and experimental demonstration testing of these units at selected utility sites.

49890 (DOE/NASA/1028—78/18) **Design and operating experience on the U.S. Department of Energy experimental Mod-0 100-kW wind turbine. NASA-TM-78915.** Glasgow, J.C.; Birchenough, A.G. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1978. Contract EX-76-A-29-1028. 17p. Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA, 20 Aug 1978.

The Mod-0 100 kW Experimental Wind Turbine was designed and fabricated by NASA, as part of the Federal Wind Energy Program, to assess technology requirements and engineering problems of large wind turbines. The machine became operational in October 1975 and has demonstrated successful operation in all of its design modes. During the course of its operations the machine has

generated a wealth of experimental data and has served as a prototype developmental test bed for the Mod-OA operational wind turbines which are currently used on utility networks. This paper describes the mechanical and control systems as they evolved in operational tests and describes some of the experience with various systems in the downwind rotor configuration.

49891 Wind power plants. A variety of plants offered in the power range between 30 W and 30 kW. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **2**: No. 3, 17(May 1977). (In German).

A brief survey of possible uses for wind power plants in power generation is followed by the range of plants the various firms have on offer. The supply encompasses 50 M plants as well as 20 kW converters.

49892 Computer aided aerogenerator analysis and performance. Base, T.E.; Russell, L.J. (Univ. of Western Ontario, London). pp A4.53-A4.74 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Theoretical and experimental studies have been made to determine the performance of both horizontal and vertical shaft aerogenerators and also to predict their performance in a turbulent approaching airflow. Computer programs have been written, based on the theory of Rankie—Froude and the Blade Element Theory, which calculates the aerogenerator performance from the blade geometry, aerofoil characteristics and wind conditions. The difficulty with most performance calculations, in the past, has been the estimation of the inflow factors a_1 and a_2. However, in the computer programs developed at the University of Western Ontario, this is overcome by an iterative technique. At present little information is available on inflow factors for vertical shaft windmills of the Darrieus rotor type. A small scale model of a straight bladed vertical axis windmill was designed, fabricated and tested in a low speed wind tunnel. Several aerofoil cross sectional shapes were used for blades. Studies have been made to determine the effect of wind shear and turbulence structure on the performance of a horizontal shaft windmill. Present tentative results indicate that the performance is changed, and in general decreased, due to the turbulence. The fluctuating drag is important for structural design reasons.

49893 Performance-optimized horizontal-axis wind turbines. Wilson, R.E.; Walker, S.N. (Oregon State Univ., Corvallis). pp B1.1-B1.28 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Design procedures for optimum wind turbines are shown to be different from those used for propellers. An optimum design generation approach for wind turbines is developed from a modified strip theory that includes tip-loss. The approach entails a local optimization of blade element parameters to maximize power output. Examples are presented that illustrate the optimum design generation procedure and off-design performance.

49894 Cross flow wind turbine. Holgate, M.J. (Univ. of Durham, Eng.). pp B2.29-B2.38 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

A theoretical analysis is presented of the operation of a type of cross flow turbine that depends for its action on angular momentum conversion rather than aerodynamic lift. Experimental results confirm the theoretical predictions to a satisfactory degree. These are that while the turbine does develop a starting torque and has a stable torque-speed characteristic, it runs at low velocity ratio and has a low efficiency of energy conversion.

49895 Wind energy conversion system based on the tracked vehicle airfoil concept. Powe, R.E. (Mississippi State Univ., Mississippi State). pp B3.39-B3.54 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

A unique momentum interchange device for extraction of energy from the wind is described. It is shown that the maximum possible energy extraction with this tracked-vehicle airfoil device is greater than that for a conventional windmill. A comprehensive mathematical model is developed for the device, and this model is programmed for solution on a digital computer. This program is written so that wind spectrum data for any geographic location can be used to determine the monthly energy output for that location. Results from this program indicate that this device could make significant contributions to electrical power requirements. For example, a system 8 km long and consisting of airfoils 12 meters in length with a 3 meter chord could supply the electrical energy needs of about 15,000 people. These results are presented in a form which indicates the effect of changing various design parameters. In addition, comparisons of the energy output of the tracked-vehicle airfoil system with typical windmills are made.

49896 Some design aspects of high-speed vertical-axis wind turbines. Templin, R.J.; South, P. (National Research Council of Canada, Ottawa). pp C1.1-C1.20 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The aerodynamic, mechanical and economic reasons are discussed for the choice of the various design parameters (rotor height to diameter ratio, solidity, number of blades, etc.) for high-speed vertical-axis wind turbines from kilowatt to megawatt sizes. It is shown that very large turbines are theoretically feasible. Various methods to prevent overspeeding, to improve the starting characteristics, and to alleviate the effects of cyclic torque and drag loads are described. The operation of the turbine at constant efficiency is compared with operation at constant speed to show that as long as the rotor speed is properly selected the constant speed mode produces nearly as much average power as the constant efficiency mode. Finally, the economics of a large turbine feeding electrical energy into an existing thermal system are considered to show that under the right circumstances the use of wind energy makes considerable financial savings possible.

49897 General performance theory for crosswind axis turbines. Lissaman, P.B.S. (AeroVironment Inc., Pasadena, CA). pp C2.21-C2.38 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Principles of energy extraction by wind machines are reviewed, it is shown that usually the Betz limit applies. However, power coefficients (based on frontal swept area) exceeding the Betz limit are possible with augmentation systems producing a duct-like flow. The inviscid theory with the viscous correction is compared with experiment; for low C the correlation is excellent for a wide class of rotors. For high C device, although the limited correlation is good, the data cover too restricted a range for definitive validation. Wind tunnel data for high C require corrections for both drag and lift wall constraints, the latter has apparently been ignored to date. The analyses provide an engineering basis for performance estimation of cross-wind machines, with sufficient structure for optimization of blade design. The consequences of neglecting unsteady terms are discussed, with suggestions for improved high C analysis.

49898 Performance prediction model for the Darrieus turbine. Strickland, J.H. (Texas Tech Univ., Lubbock). pp C3.39-C3.54 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

An analytical performance prediction model is described for the Darrieus turbine. This model is shown to predict the performance of small scale rotors, for which test data is available, with reasonable accuracy. It displays a marked improvement over older methods in which the "induced velocity" through the rotor is considered to be constant. The model is capable of predicting the overall rotor power output and the distribution of aerodynamic forces along the rotor blades. The model can be used to study the effects of rotor geometry variations such as blade solidarity, blade taper, and variations in rotor height to diameter ratios. In addition, spacial variations in freestream velocity such as that produced by atmospheric wind shear can be handled by the model. This model should be particularly useful in the design and optimization of large scale rotors for which test data is not available. Scale effects can be predicted based upon high Reynolds number airfoil data.

49899 Contribution to the aerodynamic theory of the vertical-axis wind turbine. Holme, O. (Saab-Scania AB, Linkoeping, Sweden). pp C4.55-C4.72 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

An analysis is made of the flow in the horizontal plane of symmetry of a fast running vertical-axis wind turbine having a great number of straight, very narrow blades and a high height-diameter ratio. The analysis is rigorously valid for only very lightly loaded turbines in incompressible nonviscous flow, but approximations for heavier loading and corrections for viscous effects are derived. It is found that half of the flow retardation caused by the turbine takes place within the turbine itself. Thus blade incidence and aerodynamic load on the blades are much higher on the windward than on the leeward side of the turbine. The maximum value of the power coefficient in non-viscous flow for this type of turbine is 92% of the theoretical maximum for an ideal wind turbine.

49900 Aerodynamic studies on vertical-axis wind turbine. Swamy, N.V.C.; Fritzsche, A.A. pp C5.73-C5.80 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Some studies on Darrieus type rotors undertaken at Dornier System, Friedrichshafen, Germany and I.I.T., Madras are described. As a first step, the actual shape of the rotor blades in a centrifugal force field is compared with a quadratic parabola and a catenary for different rotor height-diameter ratios. The optimum ratio of arc length and swept area is considered. For a quadratic parabola, the contribution to the torque from the various segments of the rotor has been determined. It is found that the central 60% of the rotor contributes more than 95% of the total torque. A comparison with a corresponding cylindrical rotor shows that the latter of identical maximum diameter generates about 2 to 3 times as much torque as the bend rotor. Preliminary calculations show that using a small segment of the central part of the rotor as a spoiler regulates the circumferential speed of the rotor at high wind speeds. Further studies in this direction are under progress.

49901 Low cost windmill rotor. Baxter, A.C. (Univ. of Leicester, Eng.). pp C8.101-C8.108 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The rotor is of the vertical axis type developed in Canada by the National Research Council, Ottawa. The new design replaces the rigid aerofoil section of that design with a fabric sleeve enclosing steel leading and trailing edges. The fabric is tensioned and the blade is then formed into a catenary shape to minimize the blade stresses due to centripetal action. Model tests have been carried out to investigate the new design. A rigid aerofoil is compared with one blade formed by stretching parachute fabric between two rods held apart by springs and with another blade formed by stretching a latex rubber film over the rods. The paper discusses the promise of the design, the effects of non-uniform tension in the fabric, the effect of the centripetal field on the fabric and the effect of non-uniform wind velocity on the behaviour of a vertical axis windmill.

49902 WVU wind energy concentrators. Loth, J.L. (West Virginia Univ., Morgantown). pp E2.17-E2.30 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Three wind turbine configurations whose performance is not restricted by the Betz limit are described. All are placed partially or entirely inside a region of low pressure and high velocity. It is the configuration of the turbine or its associated nonrotating device which creates a low pressure region around the turbine. This causes a concentration of the wind energy by accelerating it to higher than free stream velocities. Three types of concentrators are described: the cylindrical obstruction, the cylindrical Darrieus rotor, and the wing tip vortex type. The venturi or shrouded wind turbine is not included.

49903 Windmills with diffuser effect induced by small tipvanes. van Holten, T. (Delft Univ. of Tech., The Netherlands). pp E3.31-E3.46 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

Betz's formula for the maximum power output of windmills is valid only for windmill types extering a steady, axial force on the air. Types not covered by Betz's analysis, such as windmills applying radial as well as axial forces to the air, may have a much larger power output. This report deals with a type of windmill where relatively small vanes, attached to the tips of the millblades, deflect the air radially outwards. The diffuser effect caused by the tipvanes downstream of the windmill is associated with a general type of flow resembling a Venturi-flow, where the windmill is placed near the narrowest part of the streamtube. The resulting increased mass flow through the disc plane of the windmill causes a larger power output per unit area swept by the millblades.

49904 Aerodynamic performance theory for the Darrieus wind turbine. Sharp, D.J. (Kingston Polytechnic, Eng.). pp X46-X53 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The blade element and momentum theories are employed to predict the form of the induced velocity distribution over the vertical height of the turbine. The aerofoil data for a wide range of Reynolds numbers has been used and therefore the changes in relative wind velocity from point to point on the blades are accounted for.

POWER CONVERSION SYSTEMS

49905 (HCP/T22221—01/3) **Applied research on energy storage and conversion for photovoltaic and wind energy systems. Volume III. Wind conversion systems with energy storage. Final report.** (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Jan 1978. 330p. Dep. NTIS, PC A15/MF A01.

The variability of energy output inherent in wind energy conversion systems (WECS) has led to the investigation of energy storage as a means of managing the available energy when immediate, direct use is not possible or desirable. This portion of the General Electric study was directed at an evaluation of those energy storage technologies deemed best suited for use in conjunction with a wind energy conversion system in utility, residential and intermediate applications. Break-even cost goals are developed for several storage technologies in each application. These break-even costs are then compared with cost projections presented in Volume I of this report to show technologies and time frames of potential economic viability. The report summarizes the investigations performed and presents the results, conclusions and recommendations pertaining to use of energy storage with wind energy conversion systems.

SITE CHARACTERISTICS

49906 Mathematical modelling of topographic effects on wind. Freeman, B.E.; Taft, J.R. pp A3.39-A3.52 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

It is generally recognized that economic operation of large-scale wind energy installations must be preceded by a comprehensive study to select optimum wind energy sites. The survey must consider how sites can be expected to differ from each other with respect to their multi-year wind characteristics. A new step to overcome serious deficiencies in wind characteristics assessment procedures is described. This step employs mathematical model-based meteorological prediction tools. With them climatological data from weather stations in the region are used to infer climatological data at the unmeasured locations within the region. Meteorological phenomena are considered which take place in regions comparable to the distance between synoptic weather stations (approximately 200 km) and in the immediate vicinity of the windmill site (approximately 1 km). Computer codes were developed for each of these regimes, and calculations of wind flow over complex terrain have been performed. Results of some of these wind calculations are presented, illustrating the effects of terrain on wind energy potential.

49907 Wind tunnel simulation of the influence of two dimensional ridges on wind speed and turbulence. Meroney, R.N.; Sandborn, V.A.; Bouwmeester, R.; Rider, M. (Colorado State Univ., Ft. Collins). pp A6.89-A6.104 of Wind energy systems. Stephens, H.S.; Patel, M.P.; Coles, N.G. (eds.). Cranfield, Eng.; British Hydromechanics Research Association (1977).

From International symposium on wind energy systems; Cambridge, UK (7 Sep 1976).

See CONF-760909—.

The objective of this research was to increase technical capacity to locate favorable wind system sites, reduce uncertainty in the prediction or validation of the characteristics of sites, and thus

assist in the sizing and performance prediction of wind systems. The research included evaluation of low speed aerodynamics over terrain and boundary flow conditions over ridges by means of modelling and analytic techniques. Past experience with large power mills indicates that perhaps the single most important factor controlling success or failure of these systems is site selection. Measurements have been completed over triangular and sinusoidal shape hills of wind speed, static pressure variation, turbulence intensity, wall shear, and wind deflection. Hill aspect ratios studied range from $1/2$ to $1/6$ with some data available at $1/20$. Measurements of wind overspeed, streamline patterns, and turbulence changes over the topography are compared with results from boundary layer theory and rapid distortion theories. Large overspeed effects over the hills are found for the shear layers investigated.

ELECTRIC POWER ENGINEERING

49908 Scientific cooperation between electrical engineers from the Kiev Polytechnical Institute and Leipzig Technical University: a contribution to Socialist economic integration. Winoslawski, W.N.; Kloeppel, F.W. (Kiev Polytech Inst, Ukr SSR). *Energietechnik;* **27**: No. 11, 441-442(Nov 1977). (In German).

Cooperation in the following fields is described as regards the subjects involved and emphasis on research: rationalization of the technical preparation of electric power installations; design of electric power supply systems and their rationalization by means of design modules; development of a packet of computer programs "Calculation and Evaluation of Electric Power Systems"; elaboration of an "Interactive Dialog" taking into account the technological requirements, in particular, assembly at the building site; reliability of electric power systems, comprising a calculation program and coordination plan including accident prevention control. College textbooks are being jointly developed in these fields.

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 50010, 50012, 50615

49909 (AED-Conf—77-304-003) **Fire in the coaling system of the Frimmersdorf power station.** Hinterthan, W. (VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (Germany, F.R.)). 1977. 13p. (In German). (CONF-770695—7). Dep. NTIS (US Sales Only), PC A02/MF A01.

From International conference on fireside corrosion and contamination in thermal power stations; Essen, F.R. Germany (1 Jun 1977).

A fire in the coal transportation system led to an outage of ten 150 MW units of the power station. A consideration of the causes of the fire led to measures for the early detection and fighting of fires. This also includes a major building program with the aim of installing all electric power and control cables outside the coaling facilities.

49910 Desalting in Saudi Arabia: demand, production, management, associated power generation and future plans. Abdul-Fattah, A.F.; Husseiny, A.A.; Sabri, Z.A. (Riyadh Univ, Saudi Arabia). *Desalination;* **25**: No. 1, 9-44(Mar 1978).

Patterns of water demand and consumption in the Kingdom of Saudi Arabia are analyzed to extrapolate the extent of actual future desalination activities. Methods sought for supplementing the present water supply by means other than desalination are reviewed. Current production of desalted water and future plans are given. Electric power generation activities associated with water desalting are also considered to examine the role of dual-purpose plants. Patterns of power demand, production and consumption are discussed. The present management procedure of major desalting plants is presented and analyzed.

49911 Economical offshore electricity generation. Mobile power stations along the coast with high-voltage DC systems for power transmission planned. *VDI (Ver. Disch. Ing.) Nachr.;* **32**: No. 4, 2(Jan 1978). (In German).

The article presents a survey of the problems connected with an offshore power station. Depite the pure investment costs of an offshore station being higher than those for an inland plant, power station operation can be more economical offshore in important points. Planned is a project, 'swimming power stations', which is to utilize natural gas reserves in the North Sea not extractable with drilling and production platforms and pipelines. The so-called 'gas lenses' are to be exploited. They are in depth of about 60 to 80 m off the big oil fields. The gas lenses can be emptied one after the other with a swimming power station. The electric power would be transmitted to the land via a high-voltage DC transmission system.

49912 Problems of network stations for public electricity supply. Kindler, H. *Tech. Mitt. AEG-Telefunken;* **67**: No. 5/6, 237-247(Dec 1977). (In German).

Construction and equipping of network stations are to be given further consideration concerning their long-term effects on the operational safety of the stations, the life span of the transformers and the safety requirements of the environment. The extended knowledge in these fields can supply the foundation for an optimal organization.

49913 Soviet experience in power plant maintenance: development and economic introduction of technological processes and their evaluation and application in the GDR with assistance of Soviet servicing specialists. Gunin, W.P.; Fehrmann, K. (210-MW-Bloecke in der DDR, E Ger). *Energietechnik;* **27**: No. 11, 432-437(Nov 1977). (In German).

The experience of repairing 200-MW power units in the USSR is illustrated by the example of the Burshtyn power plant situated in West Ukraine. After a prolonged preparation (technological preparation, construction of auxiliary equipment, material supplies, power supplies, training of personnel), a general overhaul of the plant was carried out in 44.2 outage days. This short outage period is the target for East German power plants starting from the years 1980/1981. Using the example of the Boxberg power plant, a comparison is made regarding the amount of maintenance work presently carried out on 210-MW units in the GDR.

49914 Utilization of functional redundancy of information to solve problems of control and diagnostics of automated technological process control systems of power units. Fridman, L.I. (Cent All-Union Sci Res Inst of Complex Autom, USSR). *Teploenergetika (Moscow);* No. 11, 89-93(Nov 1977). (In Russian).

The purpose of the work is to consider methods for solving problems of control and diagnostics in power unit process control systems by means of the redundancy of primary data about the technological processes. Methods and algorithms of automatic checking of reliability of measurement of technological parameters and detection of malfunctioning data channels in the control systems are presented. The possibility of redundancy of malfunctioning measurement channels by utilizing appropriate data system channels with a mathematical model of the controlled technical process is given.

49915 Fuel losses when starting a 300 MW monoblock with a TGMP-324 boiler and a K-300-240 turbine made by Leningrad Metal Works. Shmukler, B.I.; Ivanov, N.V.; Vavilin, A.N.; Mikhailov, S.Ya.; Nosov, B.N. (All-Union Heat Eng Inst, USSR). *Teploenergetika (Moscow);* No. 10, 46-50(Oct 1977). (In Russian).

Results of industrial investigations of fuel losses of a 300 MW monoblock with a TGMP-24 gastight boiler are presented. It is shown that feedwater consumption during the firing time virtually does not depend on the level of starting losses of fuel. Based on experimental data, a method of computational determination of fuel losses is processed. Calculations are carried out for instructive starting graphs.

49916 KHD-mains substitution system with gas turbine drive. *Motortech. Z.;* **37**: No. 3, 67-68(1976). (In German).

A description is given of an emergency power supply system for a bank, especially for the electronic data processing system. Total power 4,6 MVA. In the first phase of construction gas turbine Lycoming TF 35 A, power transmission 14000 U/min, 8,4-kV-Siemens generator. The TF 35 A turbine is a version of the aeronautical turbine 55 made for use in industry. Two-shaft turbine with a multi-stage axial compressor and radial final stage driven by a two-stage axial turbine. Double-stage operation turbine. Compressor with variable entrance blades. Pump prevention system. Ring burning chamber, short construction length due to diversion. Hydromechanical control also influenceable by turbine entrance temperature.

49917 Thermal power plant. Bota, I.; Dobrescu, M.; Irimescu, G.; Turtureanu, M. (to Institutul de Proiectari pentru Industria Chimica Anorganica si a Ingrasamintelor, Bucharest (Romania)). German(FRG) Patent 2,243,950/C/. 11 Dec 1975. 3p. (In German).

In this thermal power plant a high-pressure steam turbine, coupled with an operation unit, which for example starts a production process with several waste heat sources, can be controlled and operated from a medium-pressure-heating steam network. A special high-pressure steam vessel, which would have to be heated first externally and then with waste heat, is replaced by normal medium-pressure steam vessels. The steam taken from the MP-heating steam network is brought to the needed pressure and temperature by means of an electronic compression and an externally heated superheater for controlling the HP-turbine and operation. If waste heat develops after the starting of the production process, the steam turbine is

operated using recovered steam heated in another superheater supplied with secondary heat energy.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

49918 Packing for the mist-free operation of wet cooling towers. Haellgren, K.; Schultz, M.; Harting, P.E. *Brennst.-Waerme-Kraft;* 30: No. 2, 71-73(Feb 1978). (In German).

The article describes a pack unit for cross-flow cooling towers where the whole heat exchange area can be used for pure wet operation. By changing over to combined wet/dry operation, the occurance of a vapor plume can be avoided at low outside temperatures.

49919 Atmospheric cooling tower with dry heat exchangers. Langerock, L.F.M.L.G. (to Hamon-Sobelco S.A., Brussels (Belgium)). German(FRG) Patent 2,538,216/A/. 12 Aug 1976. 21p. (In German).

The proposed construction has the aim of appreciably reducing the previously strong wind-dependence of the cooling effect of such cooling towers and to make excessive dimensions unnecessary, which were previously necessary to ensure full cooling effect. This should take place by a new arrangement of the many 'batteries' in the cooling tower, whose total constitutes the large heat exchanger. These batteries, with the pipes which have cooling air flowing across them and which contain the medium to be cooled, were, for example, previously installed nearly vertically in the large air inlet opening, which surrounds the cooling tower at the bottom like an all-round viewing window. By taking this vertical battery group inside, i.e. reducing it to a smaller diameter, e.g. with a distance from the window equal to the window height, the cooling air can enter without hindrance into the annular space between the window and the batteries. In doing so, the entry speed of the cooling air under the chimney draught, which may be artificially increased, becomes greater than the mean possible windspeed, so that the effect of the wind is appreciably reduced. The annular space, which is square in vertical section, with the side of the square equal to window height equal to battery length is closed in the upward direction by radial, horizontal, otherwise similar batteries. The open sectors between these batteries are covered. The cooling air flows through the horizontal battery group from below upwards and the vertical battery group has flow from outside inwards. To increase the heat-exchanger surfaces the batteries in both groups are arranged in a V-formation to each other. These batteries lie between the upper end of the window and the upper end of the vertical batteries, to which they are connected by pipelines.

POWER CYCLES

49920 (ORNL/TM—6314) **Potassium vapor topping cycle. Technical progress report, October 1, 1977—December 31, 1977.** Holcomb, R.S. (Oak Ridge National Lab., Tenn. (USA)). Jul 1978. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

The potassium vapor topping cycle is a concept for increasing the efficiency of the Rankine vapor cycle by raising the peak temperature by employing a potassium vapor cycle with a turbine inlet temperature of 1500 to 1600°F (815 to 870°C) in which the waste heat rejected from the condensing potassium vapor is transferred to boiling water and steam in a conventional steam cycle. An efficiency of about 50% is calculated for this cycle with a natural circulation potassium boiler fired by gas or oil. A DOE program is underway at ORNL to build a full-scale potassium boiler tube bundle and burner module and test it with water and then potassium. Operation of the boiler with potassium was initiated at the beginning of this quarter. Problems with plugging of the fill tank and condenser vent lines were encountered in the early runs. These problems were corrected and a boiling test run was made at a power level of about 1.9×10^6 Btu/hr. A small potassium leak occurred in the liquid level indicator sheath, making it necessary to replace the level indicator with an alternate level indicator system that makes use of two argon bubbler tubes. The new level indicator was installed and the boiler was nearly ready for operation at the end of the quarter.

49921 (ORNL/TM—6406) **Potassium vapor topping cycle. Technical progress report, January 1, 1978—March 31, 1978.** Holcomb, R.S. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

The potassium vapor topping cycle is a concept for increasing the efficiency of the Rankine vapor cycle by raising the peak temperature by employing a potassium vapor cycle with a turbine inlet temperature of 1500 to 1600°F (815 to 870°C) in which the waste heat rejected from the condensing potassium vapor is transferred to boiling water and steam in a conventional steam cycle. An efficiency of about 50% is calculated for this cycle with a natural circulation potassium boiler fired by gas or oil. A DOE program is underway at ORNL to build a full-scale potassium boiler tube bundle and burner module and test it with water and then potassium. The new liquid level indicator was installed, and operation was resumed in January. A total of 14 hr operation was obtained with steady boiling, and the performance tests were completed except the maximum power test. The results indicate excellent boiler performance with no problems of superheating in the boiler tubes. A potassium leak occurred at a tee in the liquid return line. A new tee has been installed and the system is nearly ready to begin endurance testing.

49922 Automatic systems in combined power plants increase safety and economy. Gstoettner, H. *M.A.N. (Maschinenfabr. Augsb.-Nuernb.) Forsch., Planen, Bauen;* No. 8, 44-50(Apr 1977). (In German).

In the combined power plant Franken I in Nuremberg-Bebersdorf, the total waste gas from the gas turbine is led as oxygen carrier into the furnace body of the steam generator, independent of the boiler charge. Coupling of the steam and gas turbine processes increases the total efficiency and is therefore more economical than a steam process alone. However, it requires special control measures which are described in the paper.

49923 Combined-cycle power plants with h.p. gas generator. Pfenninger, H. (to Brown, Boveri and Co. Ltd., Baden (Switzerland)). German(FRG) Patent 2,534,723/A/. 25 Nov 1976. 19p. (In German).

In this power plant supplied with high-pressure gas generated from coal, it is to be possible to run optional low loads with optimum efficiency and to use a limiting load device. This is achieved by decoupling the thermal energy flows of the gas turbine branch and of the steam turbine branch. On both sides a h.p. gas generator feeds the gas turbine of a loading set of chargers whose compressor feeds the gas generator. The exhaust gas flow of the first set of chargers passes successively - only partially flashed - the (main) gas turbine combustion chamber on the same shaft with the compressor and generator I, and, functioning as combustion air, a heat exchanger as steam generator for the steam turbine coupled to generator II. The main compressor on shaft I feeds its air partly as combustion air into the combustion chamber of the gas turbine, partly as supplementary air into the compressor of the set of chargers on the gas side, thus it can only be designed for partial pressure, i.e. smaller. The exhaust gas flow of the second set of chargers flows to the heat exchanger = steam generator of the steam turbine - practically fully flashed after energy release. The amount of both burnable gas portions determines independently from each other the efficiency of the (main) gas turbine and of the steam turbine. It depends on the speed of the corresponding set of chargers. This speed can be adjusted variably by means of a bypass or a throttle, because none of the set of chargers is coupled to a generator. This optional low loads may be run with the gas turbine and the steam turbine.

COMPONENTS

REFER ALSO TO CITATION(S) 50608, 50665, 50701, 50811

49924 Automatic generation control of an interconnected power system. Nanda, J.; Kaul, B.L. (Indian Inst. of Technology, New Delhi). *Proc. Inst. Electr. Eng. (London);* **125**: No. 5, 385-390(May 1978).

The stability and optimum settings of conventional automatic generation controllers for an interconnected power system having reheat steam plants was investigated. Effective application of the parameter-plane technique for obtaining optimal controller setting and sensitivity analysis has been demonstrated. Rigorous sensitivity analysis reveals that reserve of stability and optimum controller setting are sensitive to inertia constant, governor time constant, turbine time constant and reheat coefficient and barely sensitive to base load condition, synchronizing coefficient and reheat time lag. The optimum controller setting, however, is hardly sensitive to the speed regulation parameter whereas reserve of stability is quite sensitive to it. The condition for which it is possible to optimize the controller setting of an individual area, treating the rest of the system as having infinite inertia is emphasized. Analysis reveals that a reheat system has a slower response, providing smaller generation rate and higher frequency and tie deviations when compared with a nonreheat system. Investigation reveals that in a reheat system the optimum controller setting achieved without considering generation rate constraint becomes unacceptable in the presence of generation rate constraint. Also, while accounting for generation rate constraint, a relatively large value of governor speed regulation parameter can be well acceptable without significantly affecting the quality of the system response.

49925 Start-up of large synchronous generation by means of converter. Pagano, E.; Perfetto, A. (Univ di Napoli, Italy). *Energ. Elettr.;* **54**: No. 10, 473-478(Oct 1977). (In Italian).

Some fundamental definitions are recalled in connection with the limit running characteristics of ac machines, fed with variable frequency. On the basis of these definitions, useful relations are obtained to determine the apparent power of the necessary convertor, by which the start-up of a synchronous generator of given characteristics is effected within a fixed time interval. The characteristics of asynchronous and synchronous start-up and of the so-called asynchronous and synchronous hybrid start-up are considered in particular. Finally the three different types of start-up considered are compared.

49926 (FE—1787-9) **Modeling of a fluidized bed combustor with immersed tubes.** Saxena, S.C.; Grewal, N.S. (Illinois Univ., Chicago (USA). Dept. of Energy Engineering). Dec 1977. Contract EX-76-C-01-1787. 32p. Dep. NTIS, PC A03/MF A01.

Progress is reported in the development of a mathematical model of a fluidized-bed combustor. The model will include coal combustion phenomena and will incorporate basic mass transport relationships, bubble mechanics, heat transfer and configuration effects. A cold model test bed will be designed, constructed and operated to generate data in support of the effort in developing the mathematical model. In particular, experiments will provide data concerning heat transfer effects of tubes and tube bundles in fluidized beds, bubble formation, dispersion etc. Experiments have been carried out to measure the total heat transfer coefficient between 12.7 mm diameter copper tubes with different surface roughness and glass beads of different sizes. The comparison of results for the rough and technically smooth tubes revealed that the heat transfer coefficient strongly depends on the ratio of pitch (P) to particle diameter anti d/sub p/). By the proper choice of this ratio, P/anti d/sub p/, the total maximum heat transfer coefficient could be increased by as much as 40% over the value for a smooth tube with the same outside diameter. However, if P/anti d/sub p/ ratio is less than unity, the maximum heat transfer coefficient for rough tube is smaller as compared to the smooth tube. The design of the two end plates of the fluidized bed for mounting tube bundles of varying configuration and pitches has been completed and is currently under fabrication in the departmental workshop.

49927 (FE—1806-45) **Development of high temperature turbine subsystem technology to a "technology readiness status": Phase II. Progress report for April 1978.** Caruvana, A. (General Electric Co., Schenectady, N.Y. (USA). Gas Turbine Div.). 10 May 1978. Contract EX-76-C-01-1806. 93p. Dep. NTIS, PC A05/MF A01.

Design requirements for the closed loop water cooling system to be used in the Hot Gas Path Development Test Stand (HGPDTS) were completed. A high pressure system will supply cooling water to the nozzle sector, a low pressure system will supply cooling water to the gas sample probes. Test equipment to determine the flow characteristics of the HGP test nozzle cooling tubes prior to final assembly is described. The sensitivity of this test equipment to flaws in the cooling tubes is discussed quantitatively. A nine vane, one half scale, nozzle cascade was constructed and is being assembled in the transonic wind tunnel in preparation for tests to evaluate the effects of the sidewalls which approximate two half throats around the test vane on the turbine simulator nozzle. Gas side heat transfer coefficients for the simulator nozzle were calculated. Data taken on the 28 scale stationary one-g simulation of a horizontal, partial flow cooling passage have verified the analytical predictions. Thirty (30) percent of the passage perimeter can be expected to be wetted by the coolant flow under operating conditions. A three bearing rotor design was selected. The combustor configuration was shortened by four inches which might allow for a future shortening of the mid section. A risk analysis was performed for the first stage nozzle in the HGPDT as a basis for judging the risk to program success of various options in the design and manufacture of this hardware. Interstage gas path temperature profiles were calculated. Details of the design, manufacture, materials and process development status for each stage of the turbine (nozzles and buckets) are presented.

49928 Economic comparison of local transformers. Just, W. (Stadtwerke Bocholt G.m.b.H. (Germany, F.R.)). *Elektrizitaetswirtschaft;* **77**: No. 5, 164-168(Feb 1978). (In German).

In his statements the author gives simplifying explanations of a few terms such as total operating costs and maintenance costs, as well as capitalization, cash value, and capitalized iron and winding losses in the operation of local transformers. In this connection he compares, for example, several mains transformers from the point of view of their economic efficiency by using tables which have been drawn up.

49929 Systems in power-station supervision engineering and process control. A review of the Interkama 1977. Tettenborn, W. (Brown, Boveri und Cie A.G., Mannheim (Germany, R.R.). Abt. fuer Schaltanlagen, Netzleittechnik). *Elektrizitaetswirtschaft;* **77**: No. 2, 61-65(Jan 1978). (In German).

The author gives a review of the development trends and the newly developed systems for power-station supervision and system control shown at the Interkama '77.

49930 Measuring and control techniques in heating and process engineering. A review of the Interkama 1977. Weidemann, H. *Elektrizitaetswirtschaft;* **77**: No. 2, 44-54(Jan 1978). (In German).

The author gives a review of the principal new developments in the field of measuring and control techniques in heating and process engineering. In view of the large number of exhibits at the Interkama '77 the report cannot lay any claim for completeness. Neither is it intended to make critical comparisons of measuring instruments and measuring methods.

49931 Methods of corrosion control and inhibition in the boiler waters. Cavazzana, V.; Della Rocca, C. (Betz Sud, Italy). *Termotecnica (Milan);* **32**: No. 1, 13-20(Jan 1978). (In Italian).

The aim of the article is to give a synthetic description of corrosion problems in boilers and of the methods actually used to control this phenomenon. In order to rationalize the discussion, the boiler has been divided in two sections: the feedwater system and the boiler itself. The problem of condensate recovery system is not analyzed. In the first section the casuses of corrosion are discussed, in the following section the methods of control are analyzed. Different types of corrosion (pitting, caustic embrittlement, concentration corrosion, stress corrosion, erosion-corrosion) are systematically discussed. Results of a practical experience in controlling corrosion in a boiler treated with chelants are reported in the appendix. 20 refs.

49932 Boiler corrosion problems on the steam side. Parlato, P. (Mobil Oil, Napoli, Italy). *Termotecnica (Milan);* **32**: No. 1, 21-25(Jan 1978). (In Italian).

Boiler corrosion problems, their causes, and factors to be controlled to maintain trouble-free operations are described. With reference to Naples Refinery boilers, a history of the problems experienced in recent years is reported. Finally the actions taken to improve feedwater characteristics and then boiler operation are discussed.

49933 Corrosion in oil-fired high capacity boilers. problems and solutions. Labi, A.E. (Misan, Napoli, Italy). *Termotecnica (Milan);* **32**: No. 1, 31-38(Jan 1978). (In Italian).

Various problems associated with residual fuel oil firing in steam generators are taken into consideration with special regard to high-temperature corrosion and deposits, low-temperature corrosion and atmospheric pollution. Furthermore the advantages of the use of a magnesium oxide additive dispersed in oil are examined for the solution of these problems in comparison with other fuel oil additives generally used in the power stations. 10 refs.

49934 Reheater tubes internal surfaces corrosion owing to salinity. Binecchio, I. (Ente Naz per l'Energ Elettr, Piacenza, Italy). *Termotecnica (Milan);* **32**: No. 1, 45-46(Jan 1978). (In Italian).

Problems of corrosion of internal tube surfaces due to the presence of various aluminosilicate salts in feedwater are discussed and some countermeasures are suggested.

49935 Use of complexing agents in soviet steam power plants. Margulowa, T.C. (Moscow Energ Inst, USSR). *Energietechnik;* **27**: No. 11, 425-427(Nov 1977). (In German).

EDTA and the Trilon B disodium salt find wide application at the steam power plants of the uSSR for chemical purification of steam turbines (without outages but under reduced load), condensers, boilers and other thermal power equipment. However, use of complexing agents and complexing compositions for steam generators at steam and nuclear power plants is of the greatest importance. The purposes and methods of the use of complexing agents are listed in a table and explained in detail.

49936 Development of promising designs and analysis of maneuverability characteristics of off-peak steam turbines with the capacity of 500 MW and higher. Ryzhkov, V.K.; Sorokin, N.A.; Vol'fovskii, S.G.; Mitin, V.N.; Terent'ev, I.K.; Kuznetsov, V.F.; Safonov, L.P.; Khrabrov, P.V. (Cent Boiler and Turbine Inst, USSR). *Teploenergetika (Moscow);* No. 10, 2-7(Oct 1977). (In Russian).

The design of two variants of the off-peak steam turbine K-500-130 is considered and an analysis of the temperature and thermal stress state of their main elements is given. The effect of design parameters on turbine maneuverability is shown. Attractiveness of the turbine design with a combined high-and-medium pressure cylinder is pointed out. 11 refs.

49937 Supersonic cascades of the last stages of high-capacity steam turbines. Troyanovskii, B.M.; Maiorskii, E.V.; Lukin, V.V.; Garagulya, B.A. (Moscow Power Eng Inst, USSR). *Teploenergetika (Moscow);* No. 10, 7-12(Oct 1977). (In Russian).

Specific features of the supersonic flow past turbine cascades are considered. The effect of the airfoil shape on the wave structure of the flow is analyzed for the flow in narrowing cascades. Four

cascade types are recommended for the peripheral zone of rotor blades depending on particular conditions of operation of the last stage. Shortcomings of the expanding rotor cascades are noted.

49938 Erosion of trailing edges of rotor blades of the last stages of steam turbines. Lagun, V.P.; Simoyu, L.L.; Nakhman, Yu.V.; Semenov, Yu.E.; Naftulin, A.B.; Kolokol'tsev, V.M. (All-Union Heat Eng Inst, USSR). *Teploenergetika (Moscow);* No. 10, 12-17(Oct 1977). (In Russian).

Results of an investigation are presented which has revealed some causes of erosion wear of the trailing edges of steam turbine rotor blades. Ways to prevent this erosion are indicated. In particular, problems of the effect of the conditions of operation of the steam shedding arrangement on the appearance of erosion of the trailing edges are considered. Experimental investigations are described, the purpose of which is to clarify the possibility of moisture reaching the trailing edges of rotor blades from the system of cooling of the discharge steam, which in the design tested serves also to cool the exhaust pipe.

49939 Method of calculation of axisymmetrical flow in steam turbine low-pressure cylinders. Indurskii, M.S.; Rzheznikov, Yu.V. (All-Union Heat Eng Inst, USSR). *Teploenergetika (Moscow);* No. 10, 17-22(Oct 1977). (In Russian).

A method of calculation by clearances of the axisymmetrical nonviscous flow in the flow-pressure cylinder of a steam turbine is developed. The method permits calculations to be carried out for subsonic and supersonic flow velocities with determination of losses in blades under conditions of operation differing considerably from the rated ones. A satisfactory agreement between the data obtained by calculations and those obtained from experiments on natural-size turbines is shown.

49940 Modernization of the control system for the K-160-130 turbine when arranging for controlled steam bleeding. Volynskii, M.M.; Karliner, V.M.; Lezman, V.I.; Lyakin, A.V.; Proskurkin, V.N.; Sviridov, V.F.; Abramovich, F.A.; Glazer, F.Yu. (Cent Boiler and Turbine Inst, Khar'kov, Ukr SSR). *Teploenergetika (Moscow);* No. 10, 22-25(Oct 1977). (In Russian).

Fundamental decisions taken for modernization of the control system of the K-160-130 turbine made by Kharkov Turbogenerator Works are considered. Principal results of modernization are summarized. The control system of the modernized turbine is described.

49941 Dependence of the scale of maneuverability of heat-and-power plants on their growth rates and turbine bleeding load conditions. Gitman, M.I.; Levin, L.I. *Teploenergetika (Moscow);* No. 10, 26-31(Oct 1977). (In Russian).

The effect of the growth of the capacities of heat-and-power plants belonging to the Unified power system (UPS) of the European part of the USSR and of the turbine heat load conditions on the economically justified extent of their maneuverability is considered. The expediency of increased PT-turbine forcing at peak times following installation of peak-load boilers at heat-and-power plants is demonstrated. Indices are given permitting evaluation of the economically justified extent of maneuverability of heat-and-power plants following changes in the alternative sources of maneuvering capacity in the UPS.

49942 Properties of EP17 steel pipes for the main steamline of the R-100-300 boiler unit at kashira district electric station. Tykochinskaya, T.V. (Cent Sci Res Inst of Mach, USSR). *Teploenergetika (Moscow);* No. 10, 32-34(Oct 1977). (In Russian).

Data are given on the properties of the metal of the EP17 austenite steel pipes at control sections of the main steamline of a pilot-industrial R-100-300 boiler unit. The unit has steam parameters 650$degree$C, 30 MPa. The pipes were tested in the initial state and after the starting period of operation. The tests show that both in the initial state, as well as after the starting period and additional aging, the pipes satisfy the requirements of specifications.

49943 Restoration heat treatment of welded joints of steam piping for steam power plants. Antikain, P.A. (Cent Boiler and Turbine Inst, USSR). *Teploenergetika (Moscow);* No. 10, 34-38(Oct 1977). (In Russian).

An investigation into the effect of restoration heat treatment on the structure and properties of welded joints of steam piping is described. Eleven welded joints cut out of steam piping at different power plants after long-time operation and after r.h.t. were tested. It is shown that after normalization with 980°C and tempering at 720-730°C, the metal of the welded joints acquires microstructure close to that of the principal pipe metal. Also, mechanical properties of welded joints are improved.

49944 Sensitivity of some reliability indices to damageability of power unit equipment. Gladyshev, G.P.; Gorin, V.I. (Minenergo, USSR). *Teploenergetika (Moscow);* No. 10, 43-46(Oct 1977). (In Russian).

An evaluation of the sensitivity of reliability indices is carried out on the basis of an analysis of the dependence between the damageability of equipment and reliability indices. Samplings of statistical data for power units of different designs and capacities regarding their reliability indices (coefficients of working time, operational readiness, forced outages, utilization of installed capacity) for a period of five years are processed. It is shown that the coefficient of forced outages is the most sensitive to changes in the intensity of damages, and the coefficient of utilization of installed capacity is the least sensitive.

49945 Relating internal boiler corrosion and deposit formation to the magnetic field of steam generating tubes. Filimonov, O.V.; Vainman, A.B.; Gofman, I.N. (Volgograd Energo, USSR). *Teploenergetika (Moscow);* No. 10, 66-68(Oct 1977). (In Russian).

Some new ideas about the mechanism of deposit formation and internal boiler corrosion of waterwall tubes related to the existence of a magnetic field are expounded. A method of predicting the duration of the period of reliable operation of waterwall is proposed. It is based on the measurement of the coercitive force of the metal by a nondestructive method. 10 refs.

49946 Determination of the spectrum of dispersion of particles of corrosion products. Gromoglasov, A.A.; Mikhailov, A.Yu.; Pil'shchikov, A.P. (Moscow Energy Inst, USSR). *Teploenergetika (Moscow);* No. 10, 87-89(Oct 1977). (In Russian).

Inadequacy of the existing methods of determination of the degree of dispersion of corrosion products in power plant circulating water is noted. A device made on the basis of IKM-1 instrument for the measurement of concentration of microparticles, functioning in accordance with the conductometric method, is used to determine the fractional composition of corrosion products. Results of tests of 25 samples of feedwater are given. A calculation formula presented is in agreement with experimental data.

49947 Effect of long-time operation on the fine structure of surface layers of rotor blades of gas turbine engines. Marusii, O.I.; Koval, Yu.I.; Kaspruk, E.N.; Torgov, V.N. (Inst of Mater Strength, Acad of Sci of the Ukr SSR, Kiev). *Probl. Prochnosti;* No. 10, 103-106(Oct 1977). (In Russian).

The regularities of variation and the effect of the parameters of the substructure of the surface layers of rotor blades of transport gas turbine engines on the characteristics of the fatigue strength after prolonged operation are investigated. It is shown that the most important structural damage piling up in the course of operation is concentrated in a thin surface layer. The nonmonotonous character of variation of the fatigue strength is connected with the direction of the variation of the substructure of the surface layer inherent in the conditions of nonisothermal loading.9 refs.

49948 Calculation of radial-axial turbine stages. Birzhakov, M.B.; Litinetskii, V.V. (Leningrad Polytech Inst im. M.I. Kalinin, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 138-140(Oct 1977). (In Russian).

Results of calculation of a radial-axial turbine stage by the mean diameter and by mean integral characteristics are considered. It is shown that the calculation by the mean diameter results in substantial errors regarding the determination of the flowrate of the medium and efficiency of the stage. Equations are presented for the calculation of a stage by the mean integral characteristics for different types of the rotor blade twist.

49949 Effect of relative spacing of rotor blades on axial force in turbine stages. D'yakonov, R.I.; Kuz'michev, R.V.; Drokonov, A.M.; Sivaev, V.M. (Bryansk Inst of Transp Mach, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 140-144(Oct 1977). (In Russian).

Results of an investigation into the effect of the magnitude of the relative spacing between rotor blades on the axial force in turbine stages with different d/l ratios are presented. It is found that with an increase in the relative spacing of the rotor cascade, the axial force acting on the blade rim decreases. In order to lower the value of the axial force in an intermediate stage, it is possible to reduce the number of rotor blades within certain limits.

49950 Arrangement of tubes for a reheater. Michel, R. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,532,243/B/. 18 May 1977. 5p. (In German).

This reheater, having the task of reheating steam partially flashed and cooled down for further activity at a high-pressure stage is to eliminate the danger of superheating the lowest tube layer arranged in the hottest section of the flue gas offtake of a steam generator, and thus to eliminate its sensitivity to disturbances. This is achieved by dimensioning tube cross sections and tube lengths in a suitable manner into three tube banks through which steam flows partly successively, partly in parallel. The tube banks are piled up in the flue gas offtake. Each of them has an inlet header and an outlet header. Between each pair of headers numerous meandering tubes

are vertically arranged. The tube layer exposed to the hottest flue gas has the smallest tube diameter. This tube bank is fed with incoming steam with the lowest steam temperature and rises the temperature by 200° from 340° for example. The same temperature range is bridged by the two other tube banks connected in series with a rise in temperature of about 100° each. A spray attemperator arranged between both banks causes loss free a mean decrease in temperature. The steam velocity increased by means of a small tube cross section in the lowest layer and the heat transfer improved by this feature, together with a low-density arrangement - enlarged tube distances - ensure the effect demanded in the task set.

49951 Effect of swirl of the main air flow on the efficiency of film cooling in axisymmetric air flow past a rotating cylinder. Repukhov, V.M.; Bogachuk-Kozahuk, K.A. (Eng Thermophys Inst, Ukr SSR Acad of Sci). *Heat Transfer - Sov. Res.;* **9**: No. 2, 100-104(Mar-Apr 1977).

Experimental data on the effect of swirl of a main air flow flowing longitudinally past a rotating cylinder, on the film-cooling efficiency of the cylinder wall situated downstream of a tangential slot, are presented. It is shown that this efficiency, all other conditions being equal, is lower than that for film heating of the same rotor. Empirical equations may be used for approximate results in design of the cooling systems for gas turbines.

49952 Steam generator ancillary equipment. Heinz, A. (Allianz Versicherungs-A.G., Muenchen (Germany, F.R.). Abt. Technische Versicherungen). *Maschinenschaden;* **50**: No. 3, 77-83(1977). (In German).

From 9. Allianz forum on engineering and insurance; Muecnhen, Germany, F.R. (18 - 19 May 1976).

The author analyzes the failure susceptibility of important power station components fired by fossil fuel, such as pumps, valves and fittings, high-pressure parts, blowers, cooling units, ash removal facilities, mills, air preheaters, and electrical filters. In addition to analyzing such forms of damage, the author gives particular attention to how these power station components could be improved, and how spare parts should be kept and made available.

49953 Use of synthetic, combustion-resistant hydraulic fluids in the lubrication and control circuits of steam turbosets. Kaspar, K. (Allianz Versicherungs-A.G., Muenchen (Germany, F.R.). Abt. Technische Versicherungen). *Maschinenschaden;* **50**: No. 3, 86-92(1977). (In German).

Numerous oil fires in power stations originate from the lubrication and control oil circuits of steam turbines. So far the fire risk has been minimized by appropriate design precautions and by feeding the high-pressure control oil system with 'combustion-resistant hydraulic fluid'. A new idea is to use phosphoric ester, also a combustion-resistant fluid, in the lubrication circuit of steam turbines. The author shows the possibilities phosphoric ester offers and indicates criteria to be noted when using this fluid.

49954 Turbine and pipework internal pressure can cause major damage. Buchwald, K. (Babcock - Brown Boveri Reaktor G.m.b.H., Mannheim (Germany, F.R.)). *Maschinenschaden;* **50**: No. 6, 210-214(1977). (In German).

The author reports incidents of extensive damage cauzed by the internal pressure in the turbines and the pipework, and the consequences which such damage may have for the safety of the power plants. The possible causes of such damage are analysed against the background of some typical examples. Corresponding with an ordering of the damage causes, the report provides also some steps and recommendations for prevention of such loss. The author touches also upon the nowadays frequently debated question of using combustion-resistant fluids as a most efficacious mean against the oil fires. The report closes with an appeal to the user and the manufacturer: their joint effort should serve the further elimination of the already low number of the above mentioned damage incidents.

49955 Use of synthetic, combustion-resistant hydraulic fluids in the lubrication and control circuits of steam turbosets. Kaspar, K. (Allianz Versicherungs-A.G., Muenchen (Germany, F.R.). Abt. Technische Versicherungen). *Maschinenschaden;* **50**: No. 3, 86-92(1977). (In German).

Numerous oil fires in power stations originate from the lubrication and control oil circuits of steam turbines. So far fire risk has been minimized by appropriate design precautions and by feeding the high-pressure control oil system with 'combustion-resistant hydraulic fluid'. A new idea is to use phosphoric ester, also a combustion-resistant fluid, in the lubrication circuit of steam turbines. The author shows the possibilities phosphoric ester offers and indicates criteria to be noted when using this fluid.

49956 Operating at overspeed causes bursting of rotors and wheels in the steam turbines. Pohl, W. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Nuernberg (Germany, F.R.). Abt. Dampfturbinen). *Maschinenschaden;* **50**: No. 6, 204-209(1977). (In German).

Turbomachines are presently equipped with safety and protective devices to prevent the occurance of overspeed operations. However, overspeed damage incidents are still reported. An overspeed damage case serves the author to elucidate some typical aspects. Most damage induced by overspeed is a result of human negligence. The claim is supported by a statistical evaluation of the reported damage cases. It is therefore of an essential importance to undertake preventive measures to avoid human mistakes. In concluding, the author points to the reassuring tendency indicating a gradual decreasing of damage incidents caused by overspeed in the course of the last decade. This improvement is due to the endeavor of both, the manufacturer and the user. This development is primarily the result of a considerable improvement in the construction of the individual turbine units. The progress achieved in the passed decade, was possible because of a consistent evaluation of the experiences in operating the turbines of the foregoing generation, and due to the data obtained from a thorough analysis of various turbine parts.

49957 Firetube boiler with high efficiency for producing saturated or superheated steam. Carosso, V.J.; Carosso, J.Y. German(FRG) Patent 2,544,412/A/. 7 Oct 1976. 15p. (In German).

This boiler for producing saturated or super-heated steam is to be manufactured in one piece or in units which can be assembled at site without skilled workers, at the factory. It is to have a high efficiency and dimensions which permit the transport of the completely assembled boiler by road transport. The relatively small water-steam vessel lies across the longitudinal axis of the boiler in the rear boiler space over a battery of preheater tubes. By these measures and by a very detailed and appropriately described rational arrangement of other parts, such as convection bundles, primary and secondary superheater, evaporation tubes, which form an 'evaporation shield', upper and lower longitudinal chambers with vertical connecting pipes of different crossections, the above mentioned condition for space requirement is fulfilled and a high efficiency should be achieved, but with considerable expense.

49958 Turbine control of a thermal power station. Seippel, C. (to Brown, Boveri and Co. Ltd., Baden (Switzerland)). German(FRG) Patent 2,513,581/A/. 9 Sep 1976. 19p. (In German).

The proposed control system solves the problem of using a rated steam output fully and to the optimum extent independently of the demand, which varies greatly with the season, i.e. to produce electrical power at high efficiency with the part of the steam not required for heating at the time. This is achieved by the arrangement of turbine stages consisting of guide baffles and rotor bladge rings with adjustable rotor blades, immediately after the tapping point for the heating steam. The turbine contains a single taper high and low pressure part and a double taper low pressure part. The heating steam is extracted after the high pressure part and is taken to a heat exchanger as primary. According to the design of the plant further heat exchangers extract heating steam after the intermediate pressure and after the low pressure stage. The heating medium, usually water, is pumped as secondary medium through a series of connected heat exchangers into the network to be heated by a pump. The control of the quantity of heating steam to be extracted or its control in relation to the external temperature, takes place by the adjustable guide baffles of the intermediate stage. If the heating output is to be increased with falling external temperature, then the guide baffles are adjusted by turning the rocking levers together by a control sleeve, so that the intermediate pressure stage receives a smaller quantity of steam. This increases the steam pressure at the upstream extraction point and a higher quantity of steam flows into the heating branch. To reduce the heating output, the control process is reversed. As there is no throttling in the extracted steam flow or for the steam remaining in the turbine, as for other processes, the energy from both steam flows is used without losses in the optimum manner, even for very different division of flow.

49959 Equipment for positional stabilization of rotors of large axial steam turbines. Gemein, R.; Wotschofsky, F. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,543,689/B/. 13 May 1976. 5p. (In German).

According to the invention, the position of the rotor of a large axial turbine is stabilized by the production of a gravitational force supporting the components. This is achieved by the use of steam power, by an unsymmetrical change of the stator body and at the circumference of the running blades. The stator has a semicircular cut-out opposite each ring of running blades, whose radius, along the stator circumference declines from a maximum at the top to zero below. The stator cut-out is partnered by a trough-shaped cut-out in the ring of running blades to a channel, whose cross section is reduced from a full circle above, along the stator circumference, to (a little less than) a semicircle below. Apart from the steam flowing axially through the turbine blades, a small quantity of steam flows via a gap between stator and rotor into the newly formed channel, becomes turbulent there and supplies a centripetal

differential pressure head. This pressure is reduced in accordance with the channel crosssection along the rotor circumference from above downwards. The resultant is a vertical upward component supporting gravitational force, which is desirable for stabilisation, particularly in new large turbines with high steam forces compared with the rotor weight.

49960 Steam raising unit with a combustion chamber and at least one subsequent boiler flue. Lambrecht, F.; Zaunschirm, F. (to Waagner-Biro A.G., Vienna (Austria)). German(FRG) Patent 2,540,024/A/. 22 Apr 1976. 9p. (In German).

By construction according to the invention, the walls stressed by bending are relieved of a large part of the boiler weight. This makes it possible to choose the optimum boiler height, without any over dimensioning of the supporting combustion chamber walls which is otherwise required. Further, the pressure loss in the post-heating surfaces is reduced. Behind the combustion chamber with floor firing there are evaporation tubes in a second flue. They are collected into self-supporting bundles of four by welded cross pieces, and carry the horizontally penetrating tubes of two super-heaters. These tubes which are diverted from one level to the next by 180° bends, begin and end in a total of 4 collecting chambers outside both the boiler sidewalls. Both super-heaters (in parallel to the evaporator tubes on the outlet side) are connected in series by connecting two of these collecting chambers. There is an injection cooler in this connection on the boiler back wall. Compared with short super-heater tubes across the back wall, the tubes parallel to the back wall require fewer U-bends for the same length of tube. Thus the pressure loss in the evaporators is reduced. The back wall which has no tubes penetrating through it is not weakened, is made the falling tube of the natural circulation system and carries the steam drum, into which the evaporation tubes open. While the main load of the convection surfaces is transmitted directly to the foundations by the bundle of the evaporating tubes, the other loads, including those from the combustion chamber, steam-drum, 4 collecting chambers and injection cooler, are distributed nearly equally over the 4 boiler walls.

WASTE HEAT UTILIZATION

49961 Cogeneration. *Power Eng.;* **82**: No. 3, 34-42(Mar 1978).

In a conventional electric power plant, sufficient energy must be added to the feedwater to raise it to an energy level at which steam for power generation is produced. Due to inefficiencies in the cycle, only the energy down to the steam boiling point can be used to produce electricity. The rest of the energy is exhausted as waste heat. In a cogeneration plant energy can be extracted between the energy level at which steam for power generation is produced and the energy level at which process steam can be produced to produce electricity. From the energy level at which process steam can be produced to the boiling point of water energy can be extracted for process steam. By using heat that would be exhausted as waste in a conventional power plant, a cogeneration facility can produce a given amount of electricity and thermal energy for 10% to 30% less fuel than if they were produced in two separate facilities. It is shown, however, that of the potentially available industrial process steam for cogeneration, only about one-sixth can or will actually be available for use because of a variety of technical, institutional and financial constraints.

49962 Development trends in district heating. Voelcker, H.; Hannes, K.; Wehrum, A. (STEAG A.G., Essen (Germany, F.R.)). *Tech. Mitt.;* **70**: No. 12, 800-803(Dec 1977). (In German).

The space heating market comprises about 40% of the total energy market of the FRG an is being supplied at about 60% by light fuel oil. One way of reducing the consumption of fuel oil consists in supplying district heat by utilizing the waste heat of huge power plants (combined-cycle) of the heavy metal industrie and of refuse combustion plants. The planned supraregional interconnected system consists in heat transfer stations near waste heat sources, in the piping system and the heat transfer station at junction points to local systems. Water serves as a heat transfer medium. District heating demands for space heating currently amount to about 6-7% in the FRG. Estimations indicate that in 1990 one quarter of the total space heating requirements will be met by means of district heat generated by combined-cycle power plants. Apart from a rational utilization of energy, district heating contributes essentially to a reduction of environmental loads. The 'District Heat Transmission Line Ruhr' is a section of the planned supraregional interconnected system and is being constructed as a demonstration plant by the STEAG company.

49963 District heating in Finland: the first thermal power plant with diesel engines for district heating in Finland. Kloo, K.E. *Fernwaerme Int.;* **6**: No. 5, 251-253(Oct 1977). (In German).

The author gives a picture of the suitability of diesel engines as power engines in a power station for the combined generation of electricity and heat for district heating purposes. He also supplies aspects of how the power station ought to be designed and which construction data should be taken as a basis. Prices, compared with conventional steam power stations up to 60 MW, are competitive.

49964 Gas turbine thermal power station. Schueller, K.H. (to Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). German(FRG) Patent 2,512,774/A/. 30 Sep 1976. 13p. (In German).

This patent is concerned with the special equipment and switching of a thermal power station with as high a utilisation of the fuel as possible at high power generation with back pressure operation. One starts from the assumption that inside an area to be supplied with district heating there are groups of consumers, for whom connection via pipelines is not economic, because there is no hot water circulation system available for space heating or such a system cannot be installed, because the heat flow density is too low or the distance is too great. To supply such groups a 'heating turbine' with generator is provided apart from the gas turbine driven generator supplying the general supply network. This turbine set, fed with steam from a waste heat boiler heated with waste gas from the gas turbine, only supplies heat for these groups of consumers. The water for the heating network is heated with waste steam of the heating turbine, either in the low temperature area of the waste heat boiler or in water heaters. The calorific value of the fuel is used optimally in all load conditions by the further equipment of the plant with by-passes, temperature measuring positions, controllers and controlled valves, and by parallel controllable water heating in a steam or flue gas heated section. An auxiliary combustion chamber between gas turbine and waste heat boiler makes it possible to cover the peak demand.

ECONOMICS

REFER ALSO TO CITATION(S) 49859, 50514, 50515

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 50359, 50379, 50403, 50455

FUELS

REFER ALSO TO CITATION(S) 50517

49965 Coal firing plant of the 600 MW unit at Enstedvaerket. McLachlan, D. (Babcock Product Engineering Ltd., Crawley (UK)). *VGB Kraftwerkstech.;* **58**: No. 1, 30-33(Jan 1978). (In German).

The coal firing plant of the 600 MW unit at Endstedvaerket is combined with an oil firing plant. Construction and safety design are described, along with operating experience of single components such as feeder, milling system, pulverized-coal transport system, burner, and combustion chamber are described.

49966 Environmental considerations of converting fossil-fueled power plants from oil or natural gas to coal. Roffman, H.; Roffman, A. (Westinghouse Environmental Systems Dept., Pittsburgh). pp 152-162 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Impacts associated with coal mining, coal burning emissions to the air and discharges to water bodies are the prime public objections to the utilization of coal in power plants. For the same reasons, oil extraction and refining has been done abroad. As a result, the United States has found itself relying on oil and natural gas for over 40% of the generated electricity and importing over 80% of the oil products. Consequences of such dependence on foreign oil were the embargo of 1973 and the continuous increases in the prices of imported oil products. Although the impacts will increase as a result of the conversion from oil and gas burning to coal burning, these impacts can be significantly reduced by the utilization of available, effective mitigating measures. An objective cost/benefit analysis, that considers both the national goals related to energy utilization and the potential environmental issues, indicates that conversion to coal is a positive action and can be done in an environmentally acceptable manner.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 50517, 50984, 50995

49967 Use of an electrocoagulation method for treating effluents from thermal power stations containing oil. Zhul'kov, N.I. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 12, 53-55(1978).

Translated from Teploenergetika; 24: No. 12, 72-74(1977).

The electrocoagulation method, with the use of aluminium electrodes, can be recommended for thorough removal of oil products from thermal power station effluents, the treated water subsequently being used for supplying the water preparation plant. Iron electrodes are less effective than aluminium, at the same current density, but far more economic. It is therefore advisable to continue investigations into the use of iron plate electrodes and industrial scrap within the range of higher current density in rigs and pilot plants.

49968 New prediction formulae to compute the radio interference level due to the corona effect on ehv ac transmission lines. Cristina, S.; D'Amore, M. (Fac di Ing di Roma, Italy). *Elettrotecnica;* **64**: No. 11, 913-925(Nov 1977). (In Italian).

The similarity method is applied to obtain the generalized characteristics of the radio noise level. These curves, presented in dimensionless coordinates, are utilized to define new radio noise prediction formulae of absolute and comparative type, for wet conductor and heavy rain conditions, expressed as functions of the maximum electric gradient, of the radius and number of subconductors. The formulae are valid for a frequency up to 1 MHz and a lateral distance from outside phase equal to 15 m. Suitable arrangement of the two expressions presented, make it possible to predetermine the radio noise level also for rain, snow and fog conditions. The radio interference lateral profile and frequency spectrum are evaluated by means of two non dimensional corrective factors. The formulae obtained, modified by adding two coefficients, make it possible to compute approximately the television interference level. The validity of the expressions presented is proved by comparison between the already known experimental data and the computational results obtained for a large number of three phase power lines with different electric and geometrical parameters, in variable atmospheric conditions. 16 refs.

THERMAL EFFLUENTS

49969 (AED-Conf—77-227-001) **Application of model calculation to the energy production in the Rhine valley.** de Hug, P. (Electricite de France, 75 - Paris. Direction de l'Equipement). 1977. 6p. (In German). (CONF-7705125—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Symposium on historical development of water supply; Berlin, F.R. Germany (10 May 1977).

The generation of electrical energy in the Rhine Valley must also meet the requirements of environmental protection which are particularly strict due to the large industrialization. The geographical measures, ecological effects and the complexity of the phenomena which are to be considered have led to the development of very different types of mathematical models which give numerical data of ever greater diversification and which should be used when making technical or political decisions. One may hope that these calculation models will also determine biological elements from the determination of physical phenomena. Furthermore, they will enable one to find those targets which integrate energy demand and living standards instead of "a priori" guidelines which only protect part of man's environment and hence gamble with no apparent reason with the necessary energy production. It is possible today to state, based on our present knowledge, that there are no harmful influences.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 49350, 49418, 49429

49970 Reasons for the self-envelopment of chimneys of thermal power plants. Richter, L.A.; Gorlin, S.M.; Gavrilov, E.I.; Prochorov, V.B. (Moskovskij Ehnergeticheskij Inst. (USSR); Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Mekhaniki). *Arch. Energiewirtsch.;* **32**: No. 3, 205-212(Mar 1978). (In German).

It is shown that self-envelopment of chimneys is due to the formation of 'dilution zones' on the outer surface of the chimneys as a result of wind flow, into which the flue gases emitted from the chimneys are drawn. The main influencing parameter for the process of self-envelopment is the hydrodynamic or flow parameter I - i.e., the ratio between the dynamic flue gas pressure and the dynamic wind pressure. Self-envelopment happens when this ratio becomes smaller than 2.4. With the aid of the investigations carried out, the duration of self-envelopment may be calculated for any concrete chimney if the operating conditions of the power plant and the changes of wind velocity with time are known.

49971 Some features of the formation of nitrogen oxides in high-capacity combustion chambers with gradual introduction of air to the combustion zone. Tumanovskii, A.G. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 12, 50-52(1978).

Translated from Teploenergetika; 24: No. 12, 70-72(1977).

The main problem in reducing the overall level of pollution by gas turbine plants is to reduce the nitrogen oxides in the exhaust gases. A study is presented of the use in land gas turbine plants of high-capacity combustion chambers with gradual introduction of air to the combustion zone, part of the primary air (10 to 15% of the total flow) being supplied through the front unit and the remainder through a system of radial holes in the first rings of the flame tube. The features of fuel combustion in such combustion chambers exert an effect on the final emission of nitrogen oxides. Tests to study the features of NO/sub x/ formation in these chambers were conducted on experimental sections of the combustor for two aero engines, and also with different versions of unit-type and annular combustors specially produced for land GT plants, with different arrangements of the front unit and of air distribution.

49972 Explosion prevention on dust collectors equipped with ball mills and storage bunkers. Efroimson, O.A. *Arch. Energiewirtsch.;* **32**: No. 1, 21-27(Jan 1977). (In German).

The supply of inert flue gases as a means for drying and ventilating in dust collectors equipped with rotary ball mills and storage bunkers constitutes a highly efficient measure for explosion prevention as long as an explosion-proof oxygen content can be kept under all circumstances (below 16%). In view of more safety against explosion accidents it is of great importance to reduce the amount of dust deposite to a minimum during design, construction and operation. When revising the construction of dust collector equipment, experienced gained during operation as well as modifications of individual components carried out in power plants are to be considered. They have led to positive results while removing deposits.

49973 Environmental relief-chance for new hard coal power plants. Hecking, W.M. *Rundbrief;* No. 2, 7-8(1977). (In German).

The article shows how one can reduce the emission of harmful substances by the constructions of modern coal power plants. The following development is to be expected for the period 1975 to 1990: Maintaining a constant generation of electricity from industrial and state-owned hard coal power plants, the dust emission will be reduced from about 100,000 t per year to about 45,000 t per year in 1990. This means a reduction of about 55% compared to 400% for the period of 1950-1975. While the SO_2 emission rose with increasing production of electricity in the years from 1950 to about 1970, it will decrease considerably by 1990. The decreasing specific fuel consumption leads to a drop of about 10%. A further 15% reduction is achieved by progressing coal or flue gas desulphurization methods. One can thus calculate a total SO_2 emission of about 6000,000 t for the year 1990.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 50727

49974 (CONF-780301—) **Gaseous dielectrics.** Christophorou, L.G. (ed.). (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 462p. Dep. NTIS, PC A20/MF A01.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

Thirty papers were presented at the meeting. A separate abstract was prepared for each of 10 papers. The remaining 20 papers were not in scope for the Energy Data Base. (LCL)

49975 (CONF-780301—, pp 224-257) **Dielectric strengths of new gases and gas mixtures.** James, D.R.; Christophorou, L.G.; Pai, R.Y.; Pace, M.O.; Mathis, R.A.; Sauers, I.; Chan, C.C. (Oak Ridge National Lab., TN). May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

It is emphasized that the most effective gaseous dielectrics are gas mixtures with components chosen on the basis of fundamental physicochemical knowledge, especially on low-energy electron-molecule interactions. On the basis of such knowledge, especially on electron attachment and electron slowing down, a number of new gases and gas mixtures have been found with breakdown strengths superior to pure SF_6. These include the unitary gases c-C_4F_8 (perfluorocyclobutane), C_4F_8 (perfluorobutene-2), C_4F_6 (perfluoro-2-butyne), C_6F_{10} (perfluorocyclohexene), C_5F_8 (perfluorocyclopentene), and C_6F_{12} (perfluorodimethylcyclobutane), and the multi-component gas mixtures 20% C_4F_6 + 80% SF_6, 40% C_4F_6 + 60% N_2, 50% C_4F_6 + 50% SF_6, and 30% C_4F_6 + 20% SF_6 + 50% N_2 with DC breakdown strengths relative to SF_6 of 1 equal to 1.4, 1.8, 2.2, 2.1, 2.2, 2.4, 1.3, 1.4, 1.75, and 1.33, respectively. Findings on these and other systems are presented and discussed. Results are presented and discussed, also, on the dielectric strengths of some of the above new gases measured with cylindrical electrode geometries using different center conductor diameters. Finally, findings on the initial decomposition products of some of the new

insulators caused by electron impact are presented and their implications assessed.

49976 (CONF-780301—, pp 276-285) **Use of SF_6 or C_2F_6 in oil filled transformers.** Walsh, E.J. (Westinghouse Electric Corp., Sharon, PA). May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

Under a contract with the Electrical Power Research Institute (E.P.R.I.), studies are being conducted to evaluate the potential benefits of utilizing SF_6 or C_2F_6 saturated oils as an insulating medium in transformers. The results to date have shown that the 60 Hz electric strengths, the corona inception voltages, the impulse strengths, and the material compatibilities for the SF_6 and C_2F_6 saturated oils are all similar to nitrogen saturated oils. The effects of temperature and pressure on the solubility of these electro-negative gases in transformer mineral oil have also been investigated. It was found that both SF_6 and C_2F_6 were much more soluble than nitrogen in oil over the temperature and pressure range studied. Also studied was gas evolution under electric stress and a significant variation from nitrogen behavior was found in the Pirelli test results and in rates of gas evolution during arcing. Thermally accelerated life testing using distribution transformers containing these new gas-oil mixtures are ongoing and to date, no transformer failures have been detected. However, it was found that it was necessary to vent some of the gases from the head space over the oil to avoid excess pressure buildup in the transformer tanks. The increased pressure was due to SF_6 or C_2F_6 in the oil being released at the elevated temperatures used in these tests.

49977 (CONF-780301—, pp 286-313) **Compressed gas insulated transmission systems: the present and the future.** Cookson, A.H. (Westinghouse Electric Corp., Westborough, MA). May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

The present design of compressed gas insulated transmission lines (CGIT) consists basically of an isolated phase system with an aluminum conductor supported on cast epoxy insulators inside an aluminum sheath filled with sulfur hexafluoride (SF_6) gas typically at a pressure of 0.44 MPa (4.4 atm). These systems were first installed in 1971/72, and are now in service as high power (e.g., 3000 A) transmission links or substation getaways at voltage levels of 145 kV through 550 kV. In addition, 800 kV designs have been developed and tested. The basic CGIT design parameters are discussed with reference to the high voltage performance and operating conditions of the gaseous dielectric and the support insulators. A typical CGIT cost analysis indicates the critical parameters and the increasing importance of the SF_6 gas cost at the higher voltage levels. The significance of an improved gaseous dielectric is considered as to possible reduction of the CGIT size and the effect this would have on the design, current rating, and economics. Future CGIT system developments are discussed.

49978 (DOE/EIS—0005) **Bonneville Power Administration, proposed fiscal year 1979 program. Final environmental impact statement (final statement to INT-DES-77-30).** Liverman, J.L. (Department of Energy, Washington, D.C. (USA)). Apr 1978. 643p. Dep. NTIS, PC E08/MF E08.

This statement covers potential environmental impacts of the major new facilities and maintenance programs proposed by the Bonneville Power Administration for fiscal year 1979. Proposed new facility additions and modifications to BPA's electric transmission system include: approximately 110 miles of new transmission line; 3 new substations and related structures, including power system control stations; possible equipment additions to 18 existing substations; maintenance of approximately 12,500 miles of existing transmission lines including tower structures, conductors, and access roads; control of vegetation on approximately 19,080 acres of transmission line rights-of-way and 960 acres of substation property. Land areas in Idaho, Oregon, Washington, Montana, and Wyoming are involved. The Fiscal Year 1979 Proposed Program would result in the diversion of approximately 15 acres of forest land to other land uses compatible with transmission line rights-of-way; the permanent removal of approximately 35 acres of vegetative cover; the removal of up to approximately 12 acres of agricultural land from production; visual impacts to one scenic highway and other areas of scenic quality, disturbance of topsoil, temporary wind and water erosion, and a resultant increase in siltation and turbidity in one major waterway and numerous small and intermittent streams with consequential temporary adverse effects on fish mortality and spawning habitat; the introduction of particulates and combustion byproducts into the atmosphere during open burning of trash; introduction of herbicides into the environment; temporary reduction in wildlife habitat due to herbicides and clearing operations; audible noise during operation of construction equipment and transmission lines and substations; increased risk of man-caused accidents; and maintenance of a high standard of living and level of productivity for the Pacific Northwest through continued availability of reliable electric service.

49979 Computation of electrical field around stranded conductors using orthogonal functions. Schnider, W.; Baggenstos, H. (Fed Inst of Technol, Zurich, Switz). *Arch. Elektrotech. (Berlin);* **60**: No. 1, 41-45(Jan 1978).

The corona losses of high-voltage lines depends on the electrical field strength at the surface of the conductors. A new method is proposed for determining the electrical field strength on the surface of stranded conductors. First, an analytical solution is given for the Laplace equation. The boundary conditions are satisfied with help of orthogonal functions. The equation system for the unknown coefficients can easily be solved by backsubstitution. With this method no matrix inversion is necessary and, therefore, the numerical computations are fast and accurate.

49980 Optimal power dispatch: a new solution via augmented lagrangians. Napoli, R. (Politec di Torino, Italy). *Elettrotecnica;* **65**: No. 1, 73-91(Jan 1978). (In Italian).

The general problem of minimizing the operating cost of a thermal power system by proper allocation of active and reactive generation is formulated as a nonlinear programming problem. The augmented Lagrangian technique is used to the solution, modifying the LPNLP code. This method transforms the constrained problem into the sequential search of the saddle point for a Lagrangian function, which differs from the usual ones by some penalty-like terms. These terms are so structured as to allow fruitful use of the duality principle. Both equality and inequality constraints are treated in this way and the solution is approached by external points, avoiding the need for a feasible initial point. The Lagrangian multipliers are inherently produced at no additional effort. The theoretical inferences of stable and quick response are confirmed by sampled results.

49981 Planning of interconnected power systems today - duties and problems. Kiwit, W. (Vereinigte Elektrizitaetswerke Westfalen A.G. (VEW), Dortmund (Germany, F.R.). Hauptbereich Elektrotechnik). *Elektrizitaetswirtschaft;* **77**: No. 1, 20-25(Jan 1978). (In German).

From Lecture meeting on energy transport and environment; Aachen, Germany, F.R. (30 Sep 1977).

In the near future the 380 kV power system will be loaded increasingly due to regional supply functions exceeding grid functions tackled until now. Due to economic and operational reasons there is no alternative to conventional overhead transmission line techniques. Underground transmission lines are being developed specifically for the supply of conurbation centers. By means of concrete examples the author explaines which difficulties hamper the installation of new transmission lines and why this planning project cannot be objectified. The necessity of introducing a line voltage higher than 380 kV is not foreseen for the time being.

49982 Information for the economic control of a power system. Trojanowski, J. *Energetyka;* **32**: No. 1, 5-8(Jan 1978). (In Polish).

49983 Thermal behavior of underground power transmission lines with SF_6 insulation. Brueggemann, G. *Tech. Mitt. AEG-Telefunken;* **67**: No. 5/6, 276-281(Dec 1977). (In German).

For the calculation of the stationary load of underground SF_6 cables, a method is proposed which also takes into account the natural temperature gradient in the thermally not influenced ground as well as the uneven temperature distribution on the outer tube at any given geometric formation. A long-time test confirms the calculations. The transient behavior is described by means of time constants.

49984 Dynamic stability of an electric power system with elastic electromechanical network coupling. Selenochat, N.I.; Dunkel, H.G.; Luh, W.; Kernchen, J.; Djegtjarjew, W.N. (Moscow Energ Inst, USSR). *Energietechnik;* **27**: No. 11, 438-440(Nov 1977). (In German).

A mathematical description is given for an investigation of the equalization processes in an electromagnetically sectionalized electric power system with elastic network coupling through an asynchronized electromechanical network coupling converter. Using the example of two different designs of a network coupling converter, the dynamic properties of an electric power system are considered.

49985 Development of the power industry in Siberia and far east. Storozhuk, K.S. *Teploenergetika (Moscow);* No. 11, 70-72(Nov 1977). (In Russian).

About 2/3 of the economic potential of Soviet hydro power resources (718 out of 1095 billion kW.h) are concentrated in Siberia and the Far East. The output of coal in the Kansk-Achinsk basin by strip mining method may be brought up to 1 billion t/yr. A brief historical survey of energy development in Siberia and the Far East

is followed by a description of the prsent state of affairs and future plans. The unified power system of Siberia produced 147 billion kW.h of electric power in 1976 and its capacity was 28.8 million kW. It includes seven power systems: Maritime, Khabarovsk, Amur, Yakutian, Magadan, Kamchatka, and Sakhalin. The construction of new power plants and EHV and UHV power transmission lines is briefly outlined.

49986 Model of failures of electric power systems taking account of the dominant effect of their elements. Chan, D.L. (Moscow Power Eng Inst, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 3-7(Oct 1977). (In Russian).

A model of failures of complex electric power systems is presented, taking account only of a group of dominant cross sections. This model permits sharp reduction of the computational procedure when determining reliability indices for consumer nodes. Using a concrete example, the dependence of the calculation error on the chosen value of the dominance multiplicity factor, given variation of the latter, is investigated.

49987 Reduction of voltage fluctuation in electric systems by automatic control of excitation of synchronous machines. Zelenokhat, N.I.; Kosogorov, A.P.; Shabalin, A.E.; Khuan, B. (Moscow Power Eng Inst, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 8-12(Oct 1977). (In Russian).

The problem of reducing voltage fluctuations caused by non-attenuating or slowly attenuating wobble of rotors of synchronous machines is considered. An intensive attenuation of rotor wobble during a transient process, and consequently, a reduction in fluctuating voltage may be attained by automatic excitation control of synchronous machines. The tuning parameters of the automatic excitation control are determined through minimization of the function characterizing mutual oscillation of the rotors of synchronous machines and thus indirectly reflecting voltage fluctuation in the system. The efficacy of the automatic excitation control of different type is compared from the point of view of ensuring minimal voltage fluctuations.

49988 Problem of setting norms for and optimizing reliability of power supply. Kozlov, V.A. (Leningrad Lenenergo, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 26-31(Oct 1977). (In Russian).

Problems of determination of the most advantageous reliability in power supply systems for concrete consumers are considered. The variety of factors characterizing power supply systems and technological processes of consumers is noted. This eliminates the possibility of setting natural reliability norms. The technical and economic selection of the optimal level of reliability is not acceptable owing to the lack of uniformity in the component summary reduced costs of the power supply system, which are determined with consideration of the losses caused by interruptions in the supply of power to consumers. Under the present conditions, selection of reliability has to be carried out in accordance with the Rules for Electric Power Supply Arrangements.

49989 On the decomposition-aggregation of large scale power systems. Darwish, M.; Fantin, J.; Grateloup, G. (CNRS, Toulouse, Fr). *Autom. Control, Theory Appl.;* **5**: No. 1, 18-25(Jan 1977).

A decomposition-aggregation technique for large scale power system is developed. In this technique the system is decomposed into N subsystems using a proposed criteria by which the subsystems are known a priori and without simulating the system model. The first (N-1) of them are described by a linear model while a nonlinear one is used for the representation of the Nth subsystem. Then each linear subsystem is reduced by aggregation technique to an equivalent machine, hence reducing the order of the system. The results of application of this approach to a power system consisting of 11-machines are reported which shows its efficiency in reducing the order of the system. 14 refs.

AC SYSTEMS, EHV AND UHV

REFER ALSO TO CITATION(S) 50615

49990 (CONF-780301—, pp 314-337) **Insulation coordination of gas-insulated substations.** Eriksson, R. (Swedish State Power Board, Stockholm); Holmborn, H. May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

Gas-insulated substations (GIS) are exposed to the same overvoltages as conventional stations. Since a flashover in a GIS may seriously affect the equipment, the whole GIS must be protected against overvoltages. The shapes of overvoltages which may occur are briefly discussed as well as factors influencing these overvoltages. Critical characteristics of the surge wave, its propagation in the GIS and the influence of the size of the GIS are explained. The influence of the characteristics and location of different types of surge arresters on the maximum overvoltages is discussed, especially considering steep surges. Recommendations on suitable insulation levels BIL are given under the assumption that reasonable measures are taken in order to limit the overvoltages. GIS with the recommended BIL turns out to be less expensive than conventional substations at higher voltages. Price relations are indicated.

49991 (CONF-780301—, pp 338-354) **Statistical approach to the breakdown characteristics of large scale gas insulated systems.** Nitta, T.; Arahata, Y.; Shibuya, Y.; Kuwahara, H. (Mitsubishi Electric Corp., Amagasaki, Japan). May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

Dielectric strength of compressed SF_6 gas insulation decreases with the scale of the system. The scale effect has been shown to be brought in by the statistical property of the weak points of breakdown such as protrusions on electrode and foreign particles in the system. Problems in evaluating the breakdown characteristics of a large scale system from the data of laboratory experiments are analyzed based on the Weibull statistics of those weak points of breakdown. The Weibull statistical analysis is applied on a long coaxial cylinder bus with spacers and some other gas insulated systems.

49992 (CONF-780301—, pp 116-137) **Experience in design and testing of gas-insulated systems.** Cronin, J.C. (Gould Inc., Greensburg, PA). May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

The dielectric capability of SF_6 insulated systems is reviewed and compared with today's design practices. It is found that there is some potential for increasing impulse stress limits but that one minute power frequency factory test stress levels are already close to the limit. There is increasing interest in long term 50/60 Hz performance and results to date indicate very high stress levels can be maintained indefinitely. Contamination is a serious problem, particularly with insulators, but field conditioning techniques can help deactivate particles. Results to date on the voltage-time characteristics of SF_6 are contradictory and more work must be undertaken. D-c performance is important because of field testing requirements and the possibility that trapped charges will sometimes impose a d-c voltage on the system.

49993 (CONF-780301—, pp 206-223) **Effect of duration of voltage application and number of conducting particles on the ac breakdown strength of compressed SF_6 in a coaxial system.** Wootton, R.E. (Westinghouse Research and Development Center, Pittsburgh); Emery, F.T.; Cookson, A.H. May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

Breakdown results are presented showing the effect of duration of application of ac voltage on the strength of a 7.5/25 cm coaxial electrode system containing free conducting particles and filled with compressed SF_6. Significant differences in strength are shown to be obtained with a step procedure in which the voltage is maintained at a constant level for three minutes compared with a ramp increase in voltage at 2.3 kV/s. Further results are given which show the effect of having various numbers of free particles present in the electrode system. Significant differences in strength are obtained with variation in the number of particles from one to sixteen with both the above methods of test. Breakdown paths involving more than one particle are reported to occur in some cases. The above results are discussed in terms of statistical effects which arise from interactions between the alternating-voltage, the particle motion and a critical particle-to-electrode spacing required for breakdown in SF_6. Some possible consequences in the area of field conditioning and in procedures for field testing practical systems are discussed.

49994 Fundamental digital approach to the distance protection of e.h.v. transmission lines. Johns, A.T.; Martin, M.A. (Univ. of Bath, Eng.). *Proc. Inst. Electr. Eng. (London);* **125**: No. 5, 377-384(May 1978).

The basis of a new approach to the measurement of impedance, as used in the distance protection of transmission lines, is given. Digital processing is performed and it is shown that an extremely rapid and accurate indication of the circuit impedance can be effected by an online evaluation of the Fourier transform of a small section of the relaying waveforms. Results of an offline study of the response of the new technique when applied to a typical 400 kV line are presented. In contrast to many previously proposed methods, the new technique is shown to impose no fundamental limitation on the form of the relaying waveforms. The possibility of greatly improved protective performance emerges, one of the more important advantages being the possibility of minimal fault-detection times over the whole of the area of the impedance plane covered by a particular

relaying characteristic. The effect on performance of filtering the measurands prior to implementing the algorithms is discussed.

49995 Planning rules for high-voltage power systems. Gaertner, R. (Tech Univ, Berlin, Ger). *Arch. Elektrotech. (Berlin);* **60**: No. 1, 9-16(Jan 1978). (In German).

An important question in the planning of high-voltage power systems is the determination of the highest voltage level. A study of an idealized power transmission system should be able to give informative answers to questions mentioned above. No further details of the planned transmission system need to be known except the average power density and the average distance of transmission. One decisive parameter in this regard is the maximum allowable short-circuit current.

49996 New power switching system for fully insulated switchgear and operating voltages of 170 to 525 kV. Karrenbauer, H. *Tech. Mitt. AEG-Telefunken;* **67**: No. 5/6, 218-224(Dec 1977). (In German).

The further development of the well proven SF_6 pressure circuit breaker with insulated nozzle led to the new series of VIS load circuit breakers for operating voltages of 170 to 525 kV. The double nozzle arrangement known from the 'free jet breaker' which has been successfully applied for many years, was taken over for the insulated nozzle arc quench system in the SF_6 switchgear. The breakers are built up from switching chambers on the modular system, which is suitable for stresses associated with an operating voltage of 170 kV. The construction of the breaker and the hydraulic drive system are described. The conclusion gives an over-view of tests carried out.

49997 Electric characteristics of ducted-phase sheaths. Quilico, G. (Politec di Torino, Italy). *Energ. Elettr.;* **54**: No. 10, 454-472(Oct 1977). (In Italian).

The electric behavior of a line, whose conductors are individually contained in metallic tubular sheaths, nonferromagnetic and nonzero resistivity, interconnected to one of both ends is discussed. This is the case of both sheaths formed by unipolar cables and armored bus-bar ducts used in large power stations and recommended, as EHV connections for the transmission of considerable capacities over short distances. The current is considered in each sheath as the resultant of the corresponding line current with inverted sign and of a nonuniform angular distribution complementary current. The Fourier in series development is obtained for this distribution. Active and reactive power losses are calculated by determining line impedances, which makes it possible to express them in a singularly synthetic form. It is noted that Joule losses caused by eddy currents induced in open sheaths assume significant values in the case of bus-bar large ducts. As regards the three-phase sheath, the study is carried out on the basis of a superpositon principle of effects due to the individual single-phase system. Last, the radial distribution of the current in the sheath thickness is discussed.

DC SYSTEMS

REFER ALSO TO CITATION(S) 49911

49998 (CONF-780301—, pp 138-149) **Influence of preexisting dc voltage on the breakdown performance of SF_6 under impulse voltage.** Gockenbach, E. (Technical Univ., Darmstadt, Ger.). May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

The dielectric strength of SF_6 is determined at a voltage stress, which is typical for HVDC-converter stations, in uniform and nonuniform electrical field configurations. This voltage is verified by superposition of dc and impulse voltage. The addition of the two voltages results in the breakdown voltage, which is independent of the preexisting dc voltage in uniform and quasiuniform electrode configurations. In non-uniform electrical field configurations the breakdown voltage decreases evidently with increasing dc voltage.

49999 (CONF-780301—, pp 162-189) **Particle contamination in compressed gas insulation, limitations, and control.** Cooke, C.M. (Massachusetts Inst. of Tech., Cambridge). May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

The sensitivity of compressed gas electrical insulation to contaminant particles constitutes a basic limitation for practical apparatus which becomes even more severe in compact higher gradient systems. Though only a physically small perturbation, contaminants strongly reduce breakdown voltages in the gas gap as well as across solid insulating supports and are a major cause for substantial variations in performance. Recent studies on compressed gas insulation which emphasize methods of controlling contaminants and their effects are described. Remedies include changes which increase the tolerance of systems to the inevitable particles and also techniques for rendering them harmless. Although particle motion is complex and often determines whether or not a particle triggers failure, it can be utilized by appropriately designed electrodes which provide one way entrances into inactivating low-field trap regions. The results indicate the possibilities of substantial increases in the reliable gradients insulated by gases and improved testing strategies for installed apparatus.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 50476, 51518, 51521

50000 (AEOI—90) **Annual activity report of Atomic Energy Organization of Iran, No. 3.** (Atomic Energy Organization of Iran, Teheran). Jul 1977. 91p. (In Iranian). (PO—77-3). Dep. NTIS (US Sales Only), PC A05/MF A01.

Brief summaries of research activities carried out in all sections of AEOI during 1976 were reported. The progress made at nuclear power plants at Busher and Darkhoien, Isfahan Nuclear Technology Center, Tehran Nuclear Research Center, exploration and exploitation of nuclear fuel, radiation protection, environmental studies, safeguard and international and legal affairs, nuclear safety section, nuclear information center and the research center of radioisotope application are described.

50001 Impact of plant security programs on employees. Barton, P.H. (Duke Power Co., Charlotte, NC). *Trans. Am. Nucl. Soc.;* **28**: 677-678(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50002 Public acceptance and public relations. Communication approach to related pre-public relation problems. Tanaka, Y. (Gakushuin Univ., Tokyo (Japan)). *Genshiryoku Kogyo;* **23**: No. 7, 28-34(Jul 1977). (In Japanese).

A set of problems are discussed, which must be studied before the public relations are dealt with. Firstly, the trade-off between energy and health must be considered. Although the probability of death caused by atomic accidents is very small (one three hundred millionth a year), many peoples hate atomic power and oppose to the construction of nuclear power plants. Four reasons for this are considered: (1) social diffusion of innovation, (2) nuclear allergy, (3) shortage of the conception of risk-benefit, and (4) heterogeneity of the public. According to the investigation of the relationship between electric power and livelihood, carried out by the policyand science research institute in Tokyo, the highly subjective decision for the acceptance of atomic power is independent of the objective knowledge on atomic power.

50003 Method for desalination of condensed water. (to Crane Co., New York (USA)). Netherlands Patent 7,602,976/A/. 22 Mar 1976. 12p. (In Dutch).

A method for desalination of y water is presented, specifically a method for using hydrazine for the regeneration of charged ion exchanger resins after the condensed water is desalted via a mixed bed of ion exchange resins. This invention is particulary suited for use with steam turbine generators and nuclear power plants. The usual technique of using sodium hydroxide can cause a build up of impurities such as iron particles in the resins limiting the capacity of the ion exchanger. This is not the case for the method proposed here.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 49404, 50041, 50178, 50203, 50245, 50283, 50288, 50301, 50302, 50311, 50313, 50314, 50315, 50316, 50317, 50318, 50332, 50334, 50339, 50342, 50343, 50676

50004 (NEDO—23785) **GESTR: a model for the prediction of GE BWR fuel rod thermal/mechanical performance.** Johansson, E.B.; Potts, G.A.; Rand, R.A. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Engineering Div.). Mar 1978. 58p. General Electric Co., San Jose, CA.

The document provides a description of GESTR, a model for the prediction of GE BWR fuel rod thermal/mechanical performance. The GESTR model incorporates the effects of fuel/cladding thermal expansion, fuel/cladding creep and fuel irradiation swelling, densification, relocation, and fission gas release as they affect pellet-cladding thermal conductance, fuel rod internal pressure, and pellet/

cladding mechanical interaction. This document provides a description of the GESTR individual model elements in addition to qualification of the integral model by comparison of GESTR predictions to experimental fuel rod deformation, pellet-cladding thermal conductance, fission gas release, and fuel rod internal pressure data.

50005 (ORNL/NUREG/TM—194, pp 3-24) **Stress intensity factors for nozzle cracks in reactor vessels.** Smith, C.W.; Peters, W.H. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 12 Apr 1978.

In Heavy-Section Steel Technology Program. Quarterly progress report, October—December 1977.

Stress-intensity factor (SIF) determination for cracks emanating from the juncture of reactor vessels with inlet and exit nozzles was studied by a combination of "frozen stress" photoelastic analysis of cracked bodies and digital computer analysis. A scale model of a cracked inlet nozzle for an existing BWR vessel was investigated. It was found that stress intensities near the central region of the flaw tend to increase with increasing flaw size. The SIF varies more along the deeper flaws than the shallow ones. In addition, the flaw grows more repidly near the walls than in the center; this phenomenon produces a flattening of the flaw border in the central region. It was felt that use of intermediate test vessels yields results on crack shapes and stress fields that are within a margin of safety 20 to 50%. 14 figures, 1 table. (RWR)

50006 (ZfK—338) **Transfer of the radioactivity in the primary circuit of LWR's.** Ullmann, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Aug 1977. 17p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

In the LWR primary circuit the transfer and deposition of radioactive products causes an increase of the radiation level during the operation time. This demands extensive decontamination procedures. The relations between the parameter of operation and the mass transfer process in the circuit are analyzed. Possibilities for the reduction of the transport of radioactivity and for the understanding of this process are discussed. The building up of the activity is a result of the mass transfer (corrosion, transfer, deposition), influenced by parameters of water chemistry, material composition, construction and operation. Preliminary calculations indicate, that the oxide layer is not acting as a diffusion barrier in the corrosion process.

50007 **Deposition of iron oxide on heated surfaces in boiling water.** Asakura, Y.; Kikuchi, M.; Uchida, S.; Yusa, H. (Hitachi Ltd., Ibaraki-ken, Japan). *Nucl. Sci. Eng.;* **67**: No. 1, 1-7(Jul 1978).

The deposition of suspended iron oxide in boiling water at atmospheric pressure on a heated Zircaloy surface has been studied. The effects of various factors, including heat flux of the heated surface, concentration of iron oxide, and flow rate of boiling water, on the deposition rate during the initial period have been investigated. A model based on the microlayer evaporation and drying out phenomena that occur in the nucleate boiling bubble is proposed for an interpretation of the deposition rate. Close agreement is obtained between calculations using that model and the experimental results.

50008 **BWR thorium cycles with improved performance.** Crowther, R.L.; Bhatt, S.C.; Fennern, L.E.; Specker, S.R.; Tilley, R.M.; Townsend, D.B.; Wolters, R.A. (General Electric Co., San Jose, CA). *Trans. Am. Nucl. Soc.;* **28**: 337-339(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50009 **Note of refueling schemes for BWR cores.** Edenius, M. (Oskarshamnverkets Kraftgrupp AB, Stockholm). *Trans. Am. Nucl. Soc.;* **28**: 388-389(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50010 **Commmonwealth Edison Company plant efficiency and heat rate improvement program.** Pliml, G.J. (Commonwealth Edison Co., Chicago). *Trans. Am. Nucl. Soc.;* **28**: 672(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50011 **Condenser piping change improves nuclear unit heat rate six percent.** Crittenden, A.W.; Yang, G.Y. (Niagara Mohawk Power Corp., Syracuse, NY). *Trans. Am. Nucl. Soc.;* **28**: 672-674(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50012 **Method for power plant performance evaluations.** Kettenacker, W.C.; Land, F.D. (Energy, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 674-676(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50013 **Impact of security at a small facility.** Shimshak, R.E. (Dairyland Power Associates, Genoa, WI). *Trans. Am. Nucl. Soc.;* **28**: 677(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50014 **Sabotage potential for an insider in operating nuclear power plants.** Knuth, D.F. (KMC, Inc., Washington, DC). *Trans. Am. Nucl. Soc.;* **28**: 678-679(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50015 **Maintaining an alert security force.** Pasch, J.R. (Monticello Nuclear Generating Plant, MN). *Trans. Am. Nucl. Soc.;* **28**: 679-680(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50016 **Trends in refueling outages of light-water reactors.** Burns, E.T.; Erdmann, R.C.; Fullwood, R.R. (Science Applications, Inc., Palo Alto, CA). *Trans. Am. Nucl. Soc.;* **28**: 695-696(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50017 **ALARA impact on refueling and fuel handling activities.** Mayton, R.L. Jr. (Carolina Power and Light Co., Raleigh, NC). *Trans. Am. Nucl. Soc.;* **28**: 699(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50018 **Considerations in sizing spent-fuel pools.** Rothstein, H.L. (Ebasco Services Inc., New York). *Trans. Am. Nucl. Soc.;* **28**: 699-701(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50019 **Design considerations for in-plant fuel storage.** Zaalouk, M.G.; Biggs, W.M. (Carolina Power and Light Co., Raleigh, NC). *Trans. Am. Nucl. Soc.;* **28**: 701-702(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50020 **Water quality performance of a BWR with forward-pumped heater drains.** Blok, J.; Vanslager, F.; Asay, R. (General Electric Co., San Jose, CA). *Trans. Am. Nucl. Soc.;* **28**: 704(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50021 **Integral testing of thorium and ^{233}U data for thermal reactors.** Hardy, J. Jr.; Ullo, J.J.; Steen, N.M. (Westinghouse Electric Corp., West Mifflin, PA). *Trans. Am. Nucl. Soc.;* **28**: 714-715(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50022 **Efficient diffusion-theory parameterization for gadolinia-loaded fuel pins.** Eich, W.J. (Electric Power Research Inst., Palo Alto, CA); Mosteller, R.D.; Poetschat, G.R. *Trans. Am. Nucl. Soc.;* **28**: 728-729(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50023 Gadolinia spatial depletion measurements in BWR fuel. Crowther, R.L. (General Electric Co., San Jose, CA); Haskins, J.J.; Reager, R.D.; Smith, R.E.; Tilley, R.M.; Wolters, R.A.; Zolotar, B.A. *Trans. Am. Nucl. Soc.;* **28**: 746-747(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50024 Analysis of BNL $^{233}UO_2$—ThO_2—D_2O and H_2O exponential experiments with WIMS-D code and data. Ronen, Y.; Regev, D.; Radkowsky, A. (Ben Gurion Univ., Beer-Sheva, Israel). *Trans. Am. Nucl. Soc.;* **28**: 793-794(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50025 GE/EPRI Quad Cities 1 cold critical measurements. Crowther, R.L. (General Electric Co., San Jose, CA); Galloway, G.D.; Martin, G.C.; Petri, R.; Wolters, R.A.; Zolotar, B. *Trans. Am. Nucl. Soc.;* **28**: 795-796(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50026 Feasibility of reactivity determination from neutron noise spectral density with ^{252}Cf in the initial loading of light-water-moderated reactors. Mihalczo, J.T.; Pare, V.K. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 799-800(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50027 (BNWL-tr—320) **Degradation mechanisms during pool storage and handling of spent power reactor fuel.** Vesterlund, G.; Olsson, T. (ASEA-ATOM AB, Vaesteraas (Sweden)). Apr 1978. Translation of ASEA-ATOM preprint RB 78-29 1979-01-18. 65p. Dep. NTIS, PC A04/MF A01.

Potential degradation mechanisms for light-water fuel during pool storage are surveyed. Degradation mechanisms such as general corrosion, local corrosion, stress corrosion, hydrogen embrittlement, and delayed hydrogen cracking are not expected to produce degradation to any significant extent for 50 years. The risk of continued degradation of fuel that was defective when put into storage is shown to be small. The manageability of high-burnup fuel is good, and there are extensive experience and well-developed routines for such handling in Sweden. The dose load on personnel engaged in fuel handling is low. The handling of other components in a fuel assembly can take place in a safe manner.

50028 Valve cavitation problem solved at nuclear plant. Romania, A.R.; Stuart, C.L. Jr.; Burrell, S. (Niagara Mohawk Power Corp, Syracuse, Ny). *Power Eng.;* **82**: No. 3, 54-55(Mar 1978).

Nine Mile Point Nuclear Station No. 1 of Niagara Mohawk Power Corp. is a 650-MWe plant that started operating commercially in late 1969. A cavitation problem at this plant was found in a 4-in. globe-type feedwater flow control valve used in bypass service during low load operation. Prolonged plant outage was avoided by replacing the globe valve, on an emergency basis. A valve with a stock carbon steel body had to be used, but anti-cavitation trim has protected it from damage, in spite of cycling through 14 reactor shutdown/start-up sequences, including one hot standby when recirculating flow was maintained for a prolonged period under flashing conditions.

50029 Simplified model for the dynamics analysis of the Tarapur BWR. Gupta, H.P.; Trasi, M.S. (Bhabha Atomic Research Centre, Bombay (India). Theoretical Reactor Physics Section). *Atomkernenergie;* **31**: No. 1, 18-20(1978).

An open-loop model (which does not include the parts of the primary and secondary steam-generator loops outside the reactor vessel) is described, which analyses the dynamic behaviour of the dual-cycle Tarapur boiling water reactor. The reactor vessel is devided into three regions i.e. sub-cooled water, saturated water and steam regions, and equations are written down to express the conservation of mass, volume etc. in these regions. From these, the average fuel and coolant temperatures and core-void fractions are found, and the reactivity resulting from these is fed back to the neutronics calculation. The power transient response to a two-pump trip in the primary loops of the secondary steam generators calculated from this model compares well for the first ten seconds with the curve obtained during the start-up trials of the Tarapur reactor.

50030 Design and construction of Brunsbuettel Nuclear Power Station. Schuhmann, H. (Hamburgische Electricitaets-Werke A.G. (Germany, F.R.)). *VGB Kraftwerkstech.;* **57**: No. 11, 729-735(Nov 1977). (In German).

On 31 March 1970 the Brunsbuettel Nuclear Power Station Company awarded to Kraftwerk Union a contract for the construction and commissioning of a nuclear power station with a boiling water reactor of type 69. The plant had to be erected at Brunsbuettel within 48 months. It was handed over on 9 February 1977, 34 months late. The paper discusses the reasons for the delay, measures to strengthen the condensation chamber are described. The effects on costs of subsequent plant security and quality improvement requirements are illustrated.

50031 Moderator temperature coefficient in bwr core. Naito, Y. (Jpn At Energy Res Inst, Ibaraki-ken). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 11, 826-832(Nov 1977).

Temperature dependences of infinite multiplication factor k$infinity$ and neutron leakage from the core must be examined for estimation of moderator temperature coefficient. Temperature dependence on k$infinity$ has been investigated by many researchers, however, the dependence on neutron leakage of a BWR with cruciformed control rods has hardly been done. Because there are difficulties and necessity on calculations of three space dimensional and multi-energy groups neutron distribution in a BWR core. In this study, moderator temperature coefficients of JPDR-II (BWR) core were obtained by calculation with DIFFUSION-ACE, which is newly developed three-dimensional multigroup computer code. The results were compared with experimental data measured from 20 to 275°C of the moderator temperature and the good agreement was obtained between calculation and measurement. In order to evaluate neutron leakage from the core, the other two calculations were carried out, adjusting criticality by uniform absorption rate and material buckling.

50032 Nuclear power plants of the Soviet Union. Ermakov, G.V. (State Comm for Sci and Tech, USSR). *Teploenergetika (Moscow);* No. 11, 47-53(Nov 1977). (In Russian).

Detailed description and design diagrams of several types of Soviet reactors are given, e.g., the uranium-graphite channel reactors with aqueous heat carrier installed at the Beloyarskaya nuclear power plant; its successor, the water-graphite boiling reactors of the channel type (RBMK-1000), installed at the Leningrad nuclear power plant; its further development, the RBMK-1500 presently being installed at the Ignalinskaya nuclear power plant; the uran-graphite reactors with boiling water heat removal of the EGP-6 type installed at the Bilibinskaya nuclear heat-and-power plant (Magadan region); pressurized light water reactors of the VVER type, installed at the Novovoronezhskaya nuclear power plant, etc. Steam generators for power plants with VVER-440 and VVET-1000 reactors are described. The fast neutron breeder reactor, BN-350, installed at the city of Shevchenko in 1973 is briefly described and its design diagrams are given.

50033 Development of nuclear power engineering in the USSR. Karelin, E.P.; Sukhov, A.B. *Teploenergetika (Moscow);* No. 11, 54-59(Nov 1977). (In Russian).

Brief characteristics of the first commercial Soviet nuclear power plants are presented. In particular, descriptions of the power units at the Novovaronezhskaya, Beloyarskaya, Armenian, and Shevchenko nuclear power plants are given. It is stated that, in the long run, nuclear power plants will mainly be built in the unified power systems of the North East, Center, South, and Middle Volga of the European part of the USSR. Specific costs of nuclear power plants have been reduced to 200-210 roubles/kW, which is by about 45% higher than the costs of ordinary steam power plants of the same capacity. Prime costs of electric power produced by them are lower, however. A table of the existing nuclear power plants in the USSR is given.

50034 Graduation of enrichment in the first core of the Brunsbuettel BWR reactor. Kilian, P.; Pleuger, D. (Kraftwerk Union A.G., Offenbach (Germany, F.R.). Hauptabteilung Kernauslegung); Wallenwein, E. (Hamburgische Elektrizitaets-Werke A.G. (Germany, F.R.). Projektleitung Kernkraftwerke). *Atomwirtsch., Atomtech.;* **22**: No. 5, 273-275(May 1977). (In German).

The 770 MWe power plant at Brunsbuettel is the first of its kind with the features of the 'SWR 69' series - in particular, internal pumps in the pressure vessel - and, in the reactor core, with a new arrangement of uranium enrichment stages in the clusters. Apart from higher-enriched fuel elements, whose activity lasts several cycles, there are also low-enriched fuel elements which are spent after the very first cycle. This corresponds to the natural behaviour of the reactor in the fuel cycle. The fuel elements of the first core are equipped with the 'burnable poison' gadolinium, which has already been used in reloads, e.g. at Wuergassen. Its use in the first core is an obvious consequence.

50035 Working agreement for Barsebaeck 2. *ERA (Foeren. Elektr. Ration. Anvaendning);* **50**: No. 10, 20-21(1977). (In Swedish).

A working agreement for the re-processing of uranium from Barsebaeck 2 nuclear power station has been signed between Svensk Kaernbraenslefoersoerjning AB and the French state organisation COGEMA.

50036 Neutrons and gamma rays streaming in the annulus between the reactor pressure vessel and the sacrificial shield of the Caorso nuclear power station. Barbucci, P.; Di Pasquantonio, F. (ENEL, Milan). pp 205-213 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

As is well known, in BWR power plants, the water and the steel above and below the core, within the pressure vessel, strongly attenuate the neutron and gamma ray flux emanating axially from the core. Consequently the dose rate above and below the core, within the annulus, is dominated by the streaming components. To treat this phenomenon we have used the two-dimensional ordinate discrete code DOT-III and the Monte Carlo code MORSE. DOT-III calculates the volume source given by the core and the neutron and gamma ray fluxes entering the annulus. The first zone of the void stream, which in the Caorso plant has a thickness of about 60 cm, has been worked also by means of the DOT-III code. The ray effect has been dominated by means of a very fine asymmetric angular quadrature set of 80 angles which is a combination of S_6, S_{10} and S_{96} symmetric sets. In the upper zone of the annulus, about 260-cm-thick, the use of the DOT-III with the above quadrature set has been unsuccessful. To overcome this difficulty the MORSE code has been used coupling the S/sub N/ and Monte Carlo calculations by the DOMINO program.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 50006, 50007, 50010, 50012, 50014, 50016, 50017, 50018, 50019, 50021, 50022, 50024, 50026, 50027, 50032, 50033, 50152, 50155, 50178, 50203, 50243, 50283, 50288, 50290, 50291, 50293, 50295, 50296, 50297, 50298, 50299, 50300, 50302, 50303, 50305, 50312, 50313, 50320, 50332, 50334, 50339, 50342, 50343, 50676, 50677

50037 PWR heat rate improvements. Davis, J.S. (Duke Power Co., Charlotte, NC). *Trans. Am. Nucl. Soc.;* **28**: 670-671(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50038 Plant efficiency at Beaver Valley Power Station Number 1. Werling, J.A. (Duquesne Light Co., Shippingport, PA). *Trans. Am. Nucl. Soc.;* **28**: 671-672(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50039 Dealing with site occupations: a viewpoint and practical recommendations. Goldsmith, M.W. (Energy Research Group, Inc., Waltham, MA); Shants, F.B. *Trans. Am. Nucl. Soc.;* **28**: 680-681(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50040 Underwater fuel handling during a refueling. Evers, K.H. (Wisconsin Public Service Corp., Kewaunee). *Trans. Am. Nucl. Soc.;* **28**: 696-697(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50041 Compact portable irradiated fuel inspection stand. Scotti, V.G. (Combustion Engineering, Inc., Windsor, CT). *Trans. Am. Nucl. Soc.;* **28**: 697-698(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50042 Reactor facility with a liquid-cooled reactor. Jaschinski, G. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,606,507/A/. 1 Sep 1977. 9p. (In German).

The invention pertains to a reactor facility with a liquid-cooled reactor, in particular a PWR reactor, with a primary cooling circuit of a reactor pressure vessel and pipelines. The pipelines originate at the pressure vessel and go through a biological shield made of concrete which surrounds the pressure vessel, forming a closed space with it, and with devices for fast power removal in case of leaks in the primary circuit.

50043 Shielding design features of the floating nuclear plant. Billings, M.P.; Capo, M.A. (Offshore Power Systems, Jacksonville, FL). pp 54-63 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

The floating nuclear plant incorporates a number of shield design approaches that conserve weight and space, while meeting criteria applicable to onsite and offsite radiation exposures. Shield doors, variable-thickness shields, high-density materials, and a shielded fuel transfer crane are some of the weight-and-space-saving techniques applied. Experimental data are used liberally to verify shield designs. System operations are specifically reviewed for their effects on shielding requirements. Scale models of shielding, and penetrations thereof, are routinely prepared and incorporated into models of the overall plant, especially component arrangements and piping layouts.

50044 Empirical solution of radiation streaming problems in the air gap around the pressure vessel of a PWR. Francis, C.C. (Tennessee Valley Authority, Knoxville, TN). pp 214-222 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

In a PWR plant such as TVA's Bellefonte Nuclear Plant, it is necessary for maintenance personnel to gain access to an area directly above the reactor vessel during refueling operations. Recent calculations done to determine neutron and gamma flux around the core of a typical PWR have revealed significant resultant dose rates in the region near the closure head bolts. It was determined that the radiation streaming in the air gap was of a threefold nature, consisting of: (1) fast neutron flux emanating from the reactor core, (2) thermal neutrons resulting from scattering in the primary concrete, and (3) gamma radiation both before and after reactor shutdown. For the Bellefonte Nuclear Plant it was concluded that the best solution to the problem was an annular shaped shield located in the gap at the level of the vessel flange and consisting of cast blocks of an inorganic material, loaded with boron, and having a density of about 1-1/2 times that of water. In the course of the analysis required to resolve the annulus streaming problem many factors involving reactor cavity design and shielding were identified.

50045 Shielding against neutron streaming in pressurized-water reactors. Devillers, C. (Commissariat a l'Energie Atomique, Saclay, France); Payen, J.P. pp 223-229 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

Computational techniques used to treat neutron and gamma streaming through the air gap around the vessel of a pressurized-water reactor are described. A practical shielding arrangement consisting of two layers of different hydrogeneous materials is presented.

50046 Determination of radiation damage to structural components outside the core of PWRs. Koban, J. (KWU, Erlangen, Ger.); Leitz, C.; Hehn, G.; Issler, L. pp 238-245 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

With regard to the determination of the influence of neutron irradiation on reactor components an analysis was performed on the accuracies of neutron flux calculations and the spectral dependence of the displacement cross sections. The connection between mechanical property changes and neutron irradiation is discussed too. A comparison between calculated and measured azimuthal neutron flux distributions showed good agreement to within 11% or less. In the case of a 1300 MWe PWR the azimuthal factor for the atomic displacement rate decreases from about 5.5 at the core barrel to about 3.5 at the pressure vessel. Sensitivity studies of radiation influence in the pressure vessel of PWRs showed that the cross

sections of H, O and Fe are most important. At the inner surface of the pressure vessel of the 1300 MWe PWR benchmark problem about 80% of the total displacements are produced by neutrons in the MeV region. The atomic displacements cause a decrease of the toughness of steel during irradiation. The property change as a function of fast neutron fluence is derived conservatively from experimental data. It is shown that the operational range of a reactor vessel in every case lies far outside the zone of crack instability which is determined from the fluence dependent toughness properties. One important point within the "Structural Integrity of Components" German research project is to quantify the relation between neutron fluence, neutron spectra, and the mechanical properties of steel alloys.

50047 Study on regimes of nuclear power plants with WWER-type reactors. Akkerman, G.; Khampel, R.; Khentshel, G.; Kertsher, F.; Lyuttsov, K. (Ingenieurhochschule Zittau (German Democratic Republic)). *Teploenergetika (Moscow);* No. 11, 85-86(Nov 1976). (In Russian).

The problems are considered of optimization of nuclear fuel loading, the peculiarities of the NPP operation at decreased power, and also the problem of stability operation of NPP with WWER type reactors taking into account specific features of these reactors (partial fuel overloads, change in reactor reactivity with power changes). The two particular interconnected problems discussed are: choice of such a sequence of partial rechargings which ensures the minimum cost of the electric power generated, and increasing the reactor operating time by reducing its power output. Besides the technical and economic estimates, much attention is given to analysing the stability of NPP operation.

50048 Constructional problems during the erection of the Biblis nuclear power plant. Boernke, F. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.)). *Zentralbl. Ind.;* **22**: No. 1, 2-13(1976). (In German).

Description of the construction process of the Biblis nuclear power plant, from site selection and problems of building ground and ground water packing to design, site preparation and construction as well as to constructive problems of the buildings and the solutions of these. Special demands with regard to the explosion gas cloud, earthquakes, airplane crashes and unauthorized entry are described. Special regard is paid to the cooling from the Rhine, and its requirements.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 50032, 50033, 50184, 50307

50049 HTGR near-breeder cycles. Shirley, G.W.; Brogli, R.H. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **28**: 339-340(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50050 Resource conservation off the pebble bed prebreeder. Lee, C.E. (Texas A and M Univ., College Station); Teuchert, E. *Trans. Am. Nucl. Soc.;* **28**: 379-380(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50051 Highlights of Peach Bottom Unit No. 1 HTGR performance. Kohlr, E.J. (Philadelphia Electric Co.). *Trans. Am. Nucl. Soc.;* **28**: 685(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50052 Primary coolant chemistry at Peach Bottom HTGR and implications on large HTGR design. Burnette, R.D. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **28**: 686(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50053 HTGR nuclear and thermal design verification in Peach Bottom. Wallroth, C.F.; Saurwein, J.J. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **28**: 686-688(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50054 Metallurgical evaluation of Peach Bottom HTGR primary circuit components. Roberts, D.I. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **28**: 688(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50055 Fission gas release from Core 2 of the Peach Bottom HTGR. Hanson, D.L.; Baldwin, N.L. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **28**: 688-689(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50056 Fuel particle failure fractions in Peach Bottom HTGR fuel elements. Wichner, R.P.; Botts, J.L. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: No. 689-691, 689-691(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50057 ^{90}Sr migration in Peach Bottom HTGR fuel element graphite. Haire, M.J. (Georgia Inst. of Tech., Atlanta); Wichner, R.P. *Trans. Am. Nucl. Soc.;* **28**: 691-693(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50058 Gamma spectroscopic examination of the Peach Bottom HTGR core. Wallroth, C.F.; Holzgraf, J.F. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **28**: 693-694(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50059 Friction welding hastelloy x to carbon steel. Holko, K.H. (Gen At Co, San Diego, Calif). *Weld. J. (Miami);* **57**: No. 3, 19-27(Mar 1978).

Electric power is generated from a high-temperature gas-cooled reactor (HTGR) by circulating helium at 1460 F (793 C) between a nuclear core and heat exchangers. Thermal barrier attachment fixture fabrication is the subject of this paper. Fatigue strength surpassed design requirements for anticipated service cnditions in both the AW and PWHT conditions. Fatigue strengths were highest for weld line locations that resulted in wide carbon steel HAZs. The presence of stress concentrations from remnant upset material caused premature fatigue failure. Stress concentrations were eliminated by careful control of machining dimensions. Weld quality was high as determined by metallurgical examination. The PWHT (1600 F or 871 C/20 min/air-cooled) used is not optimum since the carbon steel HAZ was weakened. Face bend tests were easily passed but root bend tests were not. 4 refs.

50060 Development status and performance of the AGR line. Hryniszak, W. (Technische Univ., Vienna (Austria); Newcastle upon Tyne Univ. (UK)); Bainbridge, G.R. (Newcastle upon Tyne Univ. (UK). Energy Center). *Atomwirtsch., Atomtech.;* **23**: No. 1, 23-30(Jan 1978). (In German).

On the basis of the gas cooled, graphite moderated natural uranium reactor line Britain developed a nuclear industry which, up until 1975, not only had the world's largest number of nuclear power plants in operation but also regularly featured the highest electricity production rates from nuclear sources. Successful operation of that line resulted in its further development into the Advanced Gas Cooled Reactor (AGR), which uses enriched uranium. Britain is the only country to operate gas cooled reactors on a large scale, France having abandoned the concept in favor of light water reactors a number of years ago. Although the gas cooled reactor line originated from military programs, its good performance justifies Britian's adhering to this type. However, this decision is no longer undisputed.

50061 Ten years of electricity supply from AVR. Vollmer, H. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (Germany, F.R.)); Marnet, C. (Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Duesseldorf (Germany, F.R.)). *Atomwirtsch., Atomtech.;* **23**: No. 1, 31-33(Jan 1978). (In German).

On December 17, 1967 the AVR Experimental Nuclear Power Station of Juelich for the first time supplied electricity into the public grid system. AVR had been planned as a large scale experiment conducted with the following objectives in mind: demon-

stration of the feasibility of high temperature reactors (HTR's) with spherical fuel elements; functional testing of major components, especially of the fuel elements, under conditions specific of HTR's; demonstration of the reliable and safe operation of an HTR. As is proven by the ten years of operation so far, these goals have been met in full, and expectations have been exceeded by far. In addition to high long time availability, despite various starup difficulties and frequent test programs, the plant has achieved at least three records: the lowest activity level in the cooling systems, the highest coolant gas temperature (950°C) over several years of operation, and the highest fuel burnup (in excess of 183,000 MWd/te of U + Th) in a nuclear reactor.

50062 Working man's AGR. Farkasch, G. (Institution of Nuclear Engineers, London (UK)). *J. Inst. Nucl. Eng.;* **19**: No. 1, 26-29(1978).

It is stated that there are a number of aspects of the conventional AGR (Advanced Gas Cooled Reactor) design that have been criticised, and which could be improved or possibly eliminated by changing to what is known as the 'downward flow configuration'. These are listed and discussed. This configuration was studied in the early days of UK AGR technology, but was killed by the then requirement that in the event of complete gas circulator breakdown natural circulation must be available to safeguard the core in a shut down condition. The 'downward flow' concept was, however, taken up by the US Gulf General Atomics Company and became an integral part of their High Temperature Reactor design, and is still favoured. No such design, however, has so far been submitted on tender for AGR's in the UK. The UK design has been to provide a gas circulator system that could not conceivably fail completely. It is considered in this paper that the benefits that would arise directly from adoption of the 'downward flow configuration' are so great that the effort in carrying out a full scale cost exercise would be fully justified. It is also considered that the 'downward flow' carbon dioxide cooled graphite moderated reactor design would be the safest currently available in the world, and could also be the cheapest.

50063 Nuclear power plants with high temperature reactors. Promising option for future energy supply. Harder. *Energiewirtsch. Tagesfragen;* **27**: No. 12, 795-797(Dec 1977). (In German).

After a brief introduction into the HTR's state of development, the characteristics of this reactor are described in a general way. This includes uranium consumption, economy, environmental impact, and the safety potential.

50064 Feedwater chemistry for steam generators in HTR reactors. Schuetzenduebel, E.G. (General Atomic Co., San Diego, Calif. (USA)). *Energie;* **29**: No. 10, 330-333(Oct 1977). (In German).

It will still take some time to gain experience in feedwater chemistry at the Schmehausen HTR reactor. At the Fort St. Vrain 330 MW HTGR reactor, in contrast, feedwater operating values can already expressed in parts per million. The US reactor works in forced circulation; steam generator and gas compressor are integrated in the pressure vessel, and there are special demands to be made on the feedwater. The author, who works at General Atomic in the USA, states the criteria to be observed for perfect operation.

50065 Investigation of hydrogen peroxide dosing into the condensate of single-loop power block of the beloyarskaya nuclear power plant. Margulova, T.Kh.; Shchapov, G.A.; Gruzdev, N.I.; Dik, V.P.; Kotenkov, V.N.; Tyapkov, V.F.; Boguslavskii, V.B. (Moscow Energ Inst, USSR). *Teploenergetika (Moscow);* No. 10, 76-77(Oct 1977). (In Russian).

Results of an investigation to check the expediency and advantages of hydrogen peroxide dosing in neutral water conditions are presented. The dosing was carried out for two weeks at the suction inlet to condensate pumps of stage II. As a result, iron concentrations were reduced considerably. It is concluded that the assumptions that hydrogen perioxide is thermally unstable and that is has a positive effect on steel only as a result of the effect of decomposition oxygen are not correct. Hydrogen peroxide addition to the condensate is a promising method of water treatment.

50066 Fort St. Vrain plant shielding design and measurements. Su, S.; Engholm, B.A.; Sund, R.E. (General Atomic Co., San Diego, CA). pp 196-204 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

This paper reviews the shielding experience with the 330 MW(e) Fort St. Vrain HTGR plant, and reports the results of shielding measurements during initial rise-to-power. The measured radiation levels at 28% power were generally undetectable or lower than the calculated values. Comparisons of the predicted and actual shielding performance show that the plant shielding has met or exceeded the design requirements. Therefore, no radiation problems are expected under normal full-power operation.

50067 Neutron and gamma ray transport studies in the helium ducts and the Turbo-Groups of a high temperature reactor with helium turbine (HHT), using the Monte Carlo method. Taormina, A.; Kypreos, S. (EIR, Wuerenlingen, Switzerland). pp 262-270 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

This report describes the calculation of neutron and gamma ray fluxes and dose rates in the Helium ducts and the Turbomachinery of various HHT designs. The PCRV geometry and the arrangement of the Helium Turbines is described and the different material specifications are summarized. The neutron source at the level of the core support system is defined using the discrete ordinates approximation of the transport equation in the reactor core. The complicated shielding requires an exact three dimensional solution of the neutron and gamma ray transport. This is obtained using the Monte Carlo program FMCEIR which is briefly described. Neutron fluxes and dose rates are given for the different HHT designs. The effectiveness of a boronate graphite wall to attenuate the neutron flux and to reduce the dose rate is also examined. The source is divided into different energy groups to study how the calculated results are affected by the thermal, epithermal and fast source neutrons. The variance is calculated by grouping the histories and the Shapiro-Wilk normality test is performed.

50068 Neutron dosage at steel components in the THTR. Wahsweiler, H.G. (Hochtemperatur-Reaktorbau Gmbh, Cologne); Hehn, G. pp 280-287 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

The fast neutron fluence to steel components in the upper region of the high-temperature pebble bed reactor THTR-300 under construction in Germany is discussed. The shielding calculations through the heterogeneous 2 m thick graphite top reflector have been performed mainly by combined use of ray analysis and two-dimensional S/sub n/-method. The design objective which has been achieved is the restriction of the fast fluence ($E > 0.1$ MeV) to structureal parts of low-alloy steels to less than 10^{18} cm^{-2}.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 50024, 50345

50069 (BARC—918) Fabrication and post-irradiation examination of a zircaloy-2 clad UO_2-1.5 wt% PuO_2 fuel pin irradiated in PWL, CIRUS. Sah, D.N.; Sahoo, K.C.; Chatterjee, S.; Majumdar, S.; Kamath, H.S.; Ramachandran, R.; Bahl, J.K.; Purushottam, D.S.C.; Ramakumar, M.S.; Sivaramakrishnan, K.S. (Bhabha Atomic Research Centre, Bombay (India)). 1977. 28p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A zircaloy-2 clad UO_2-1.5 wt% PuO_2 fuel pin was fabricated at the Radiometallurgy Section of the Bhabha Atomic Research Centre, Bombay, for irradiation in the pressurised water loop in CIRUS. Requisite development work related to powder conditioning, blending, pressing and sintering parameters was carried out to meet the exacting fuel pellet specifications of CANDU fuel. The fuel pin ruptured while being irradiated in the pressurised water loop in CIRUS, after experiencing a low burn-up of 507 MWD/MTM and was subsequently examined at the Radiometallurgy Hot Cells Facility. The results showed that internal clad hydriding led to primary failure of the fuel pin. Subsequent ingress of the coolant water caused excessive swelling of the thermal insulating magnesia pellets located at the ends of the fuel column.

50070 Preliminary physics design of a pressurized heavy-water reactor. Sehgal, B.R.; Yang, C.S. (Electric Power Research Inst., Palo Alto, CA). *Trans. Am. Nucl. Soc.;* **28**: 723-724(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50071 Thermal breeding with a mixed denatured fuel. Filippone, W.L.; Martin, J.G. (Univ. of Lowell, MA). *Trans. Am. Nucl. Soc.;* **28**: 724-725(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 49725, 50032, 50033, 50149, 50151, 50181, 50207, 50244, 50247, 50280, 50281, 50282, 50285, 50310, 50321, 50322, 50323, 50324, 50325, 50326, 50327, 50328, 50341, 50344, 51442

50072 (EPRI-NP—645-SY(Vol.1)) **Engineering aspects of the pool type LMFBR, 1000 MWe. Final report.** McDonald, J.S.; Golan, S. (Atomics International Div., Canoga Park, Calif. (USA); Bechtel Corp., San Francisco, Calif. (USA)). Apr 1978. 57p. Dep. NTIS (US Sale Only), MF A01.

The diverse directions of LMFBR development in the national programs here and abroad have established that both the loop-type and the pool-type of primary coolant systems should be considered to be viable options for an LMFBR power plant of practical size. Recognizing that the U.S. technological base for the pool-type plant was significantly smaller than that for the loop-type, this study of a 1000 MWe pool-type plant was concentrated on the areas of the plant unique to the pool concept to establish a more adequate basis for reassessment of the pool concept. The work concluded to date indicates that the pool concept is feasible with respect to design, construction and licensing practice in the United States. Volume 1 summarizes the work to date.

50073 (EPRI-NP—645(Vol.2)) **Engineering aspects of the pool type LMFBR, 1000 MWe. Final report.** McDonald, J.S.; Golan, S. (Atomics International Div., Canoga Park, Calif. (USA); Bechtel Corp., San Francisco, Calif. (USA)). Apr 1978. 515p. Dep. NTIS (US Sale Only), MF A01.

Portions of document are illegible.

This volume presents the conceptual design and performance characteristics of a 1000-MWe pool-type Liquid Metal Fast Breeder Reactor (LMFBR) electric generating power plant.

50074 (EPRI-NP—645(Vol.2)(App.)) **Engineering aspects of the pool type LMFBR, 1000 MWe. Final report.** McDonald, J.S.; Golan, S. (Atomics International Div., Canoga Park, Calif. (USA); Bechtel Corp., San Francisco, Calif. (USA)). Apr 1978. 262p. Dep. NTIS (US Sales Only), PC A12/MF A01.

Appendices to Volume 2 include detailed information under the following headings: NSSS system and equipment data sheets, deck trade study, rotatable plug and seal study, reflective insulation experience, fuel handling and storage, seismic design criteria, major component maintenance approach, radiation protection philosophy and criteria, NSSS design criteria, alternate to IHTS piping concepts, and safety licensing evaluation of IHTS and DDHRS containment isolation requirements.

50075 (EPRI-NP—645(Vol.3)) **Engineering aspects of the pool type LMFBR, 1000 MWe. Final report.** Golan, S. (Bechtel Corp., San Francisco, Calif. (USA)). Apr 1978. 259p. Dep. NTIS (US Sale Only) MF A01.

Portions of document are illegible.

This volume reports the results of the balance-of-plant (BOP) work carried out under Phase A of the Prototype Large Breeder Reactor (PLBR) program sponsored by EPRI. The primary objective of BOP work for Phase A was to develop an integrated NSSS/BOP conceptual design under U.S. conditions for a 1000 MWe pool LMFBR utilizing a saturated steam cycle. The conceptual design was to be carried to sufficient depth to establish the technical feasibility of the major structures and systems unique to the pool concept and to investigate their practicality. This report describes the overall arrangement, major structures and systems, and provides engineering evaluations for key pool-related areas. Features affecting constructibility of a pool-type plant are also evaluated and areas requiring further study and resolution are identified. A detailed comparison between the pool and the loop was not performed; however, a number of general observations are noted.

50076 (EPRI-NP—646(Vol.1)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Part II. Heat transport systems, final report.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1978. 215p. Dep. NTIS, PC A10/MF A01.

The results of a study on the design of heat transport systems for a 1000 MW(e) pool-type LMFBR are presented. The systems included decay heat removal as well as primary and intermediate heat transport systems.

50077 (EPRI-NP—646(Vol2.)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Part II. Appendixes, final report.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1978. 150p. Dep. NTIS, PC A07/MF A01.

A detailed study on the preliminary design of an intermediate heat exchanger for a 1000 MW(e) pool-type LMFBR is presented.

50078 (EPRI-NP—646(Vol.3)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Part III. Deck structure, final report.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1978. 284p. Dep. NTIS, PC A13/MF A01.

The results of a detailed study on the design of the deck structure for a 1000 MW(e) pool-type LMFBR are presented.

50079 (EPRI-NP—646(Vol.4)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Part IV. Reactor assembly and core, final report.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1978. 544p. Dep. NTIS, PC A23/MF A01.

The results of a detailed design study on the reactor assembly and core for a 1000 MW(e) pool-type LMFBR are presented.

50080 (EPRI-NP—646(Vol.5)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Part IV. Appendix, final report.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1978. 90p. Dep. NTIS, PC A05/MF A01.

The results of an engineering study of the design, fabrication, construction, and testing of the major structural components of a pool-type 1000 MW(e) LMFBR are presented.

50081 (EPRI-NP—646(Vol.6)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Part V. Auxiliary systems. Part VI. Research and development needs, final report.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1978. 239p. Dep. NTIS, PC A11/MF A01.

The results of an engineering study of auxiliary systems design and of additional research and development needs for a 1000 MW(e) pool-type LMFBR are presented.

50082 (EPRI-NP—646(Vol.7)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Part VII. Balance-of-plant final report.** (Bechtel Corp., San Francisco, Calif. (USA)). Apr 1978. 455p. Dep. NTIS, PC A16/MFA01.

The results of an engineering study of the balance-of-plant design for a 1000 MW(e) pool-type LMFBR are presented.

50083 (EPRI-NP—646(Vol.8)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Part VI. Appendixes, final report.** (Bechtel Corp., San Francisco, Calif. (USA)). Apr 1978. 187p. Dep. NTIS, PC A09/MF A01.

Equipment lists, piping class sheets, plant drawings, and a Q-list (items subject to quality assurance program) for a 1000 MW(e) pool-type LMFBR are presented.

50084 (EPRI-NP—646(Vol.9)) **Pool-Type LMFBR Plant 1000 MWe Phase A design. Appendix: innovative design features, final report.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1978. 42p. Dep. NTIS, PC A03/MF A01.

The results of a study of innovative design features for a 1000 MW(e) pool type LMFBR are presented.

50085 (HEDL-SA—1363S) **US—UK technical exchange breeder reactor fuels. Fuel pin chemistry (supporting information).** (Hanford Engineering Development Lab., Richland, Wash. (USA)). 14 Oct 1977. Contract EY-76-C-14-2170. 55p. (CONF-7710139—1). Dep. NTIS, PC A04/MF A01.

From US-UK technical exchange; Sunnyvale, CA, USA (14 Oct 1977).

The following information covering the two topic areas of fuel pin chemistry; fuel-cladding chemical interaction and cesium behavior will not be formally exchanged with the UK representatives prior to the October 14, 1977, meeting at GE in Sunnyvale, California. This information will only be presented to the UK representatives at the exchange meeting if they offer new information of comparable technical value. Data are presented on irradiation behavior and performance of mixed oxide LMFBR fuels. (DG)

50086 (INB—414) **Monthly report No. 9 (September, October, and November 1977) of INTERATOM representative to Westinghouse Hanford Co., Richland, Washington (USA).** Mayer, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). 30 Nov 1977. Contract EY-76-C-14-2170. 41p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The following topics are mentioned: alternate breeder fuel cycles (Shippingport Light Water Breeder Reactor), Clinch River Breeder Reactor status, FFTF status, LMFBR component development, and PLBR status. (DG)

50087 **Birth of the breeder.** Hinton, C. (Electricity Supply Research Council, London (UK)). pp 8-13 of Breeder reactor. Forrest, J.S. (ed.). Edinburgh; Scottish Academic Press (1977).

From Meeting on the breeder reactor; Strathclyde, UK (25 Mar 1977).

The background to the development of the British fast reactor programme is summarized. The problem of design proved to be even more difficult than had been expected and only a small team could be allocated to the work. A zero energy facility was built at

Harwell and the small team of engineers at Risley started design of a 60 MW (thermal) experimental reactor. The reactor was commissioned in 1959; it was designed to give experience of control of fast reactors, to give experience of the use of liquid metals as coolants and to provide a facility for the development of fuel elements suitable for industrial fast reactors. It was more than successful in all of these things.

50088 (IWGFR—21, pp 123-132) **Vibration studies of BN-350 and BN-600 steam generator tube bundles.** Fyodorov, V.G.; Lyashenko, V.V.; Sokolov, A.S.; Lukasevitch, B.I.; Testov, I.N.; Titov, V.F. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

The report contains results of vibration studies on BN-350 superheater tube bundles on seven-tube simulators and full-scale steam generators, and of BN-600 vaporizer tube bundles on a multi-tube simulator. The discussion covers main vibrational characteristics of tubes of these steam generators, methods of estimation of full-scale steam generator tubes life derived from results of model vibration tests, and results of repeated in-service checks of BN-350 superheaters vibration. The report deals with vibration strength criteria and limiting norms of tubes vibration. It also provides a description or a method of tube vibration measurements, and steam generator designs.

50089 (IWGFR—21, pp 165-196) **Experimental studies of flow induced vibrations of the fuel assembly for the PEC reactor.** Pitimada, D.; Presaghi, M.; Tampone, O.; Cesari, F. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

The vibration behaviour of an assembly of seven mock-up fuel bundles of PEC reactor has been investigated. The assembly was excited by a parallel flow of water simulating sodium. The motion of the group (or of a single bundle in the group) has been measured in transverse sections detecting two orthogonal components of displacement. During the experiences the following parameters were varied: bundle foot and pads restraints, flow rate condition, coolant flow outlet conditions at the head of fuel bundles. Experimental data were processed in order to obtain: trajectories of three points of fuel bundle axis, power density spectra of measured vibration amplitudes, correlations between coolant flow rate and vibration amplitude R.M.S.

50090 (IWGFR—21, pp 197-210) **Analysis of flow induced vibration in heat exchangers.** van Beek, A.E. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

A description will be given of three different types of heatexchangers developed by the Dutch Nuclear Industry Group "Neratoom" in cooperation with TNO for the sodium-cooled fast breeder reactor SNR-300 at Kalkar. Moreover, the research related with flow induced vibrations carried out by TNO (Organization for Applied Scientific Research) will be presented. The flow induced forces on the tubes of the straight-tube steam generators were measured at the inlet and outlet section where partial cross-flow occurs. With the measured flow induced forces the response of a tube was calculated as a function of the tube-to-supportbush clearances taking into account the non-linear damping effects from the sodium. The theoretical results showed that for this particular design no tube impact damage is to be expected which was confirmed later by a full scale experiment. Special attention will be devoted to the steam generator with helical-coil tube-bundles, where the sodium flows in a counter cross-flow over the tube-bundle. Extensive measurements of the power spectra of the flow induced forces were carried out since no information could be found in the literature. The vibration analysis will be presented and vibration modes of the entire bundle will be compared with experimentally obtained results. Finally a description of the vibration tests to be carried out on the intermediate heatexchanger (IHX) will be presented.

50091 (IWGFR—21, pp 212-223) **Review of ANL base technology studies in support of the U.S. LMFBR vibration program.** Wambsganss, M.W.; Chen, S.S.; Mulcahy, T.M.; Shin, Y.S. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

Argonne National Laboratory (ANL) is the center for base technology studies of flow induced vibration for the US LMFBR Program. This paper reviews and summarizes published results, reports on the status of ongoing programs, and discusses future needs as outlined in the US LMFBR Vibrations Program Plan.

50092 (IWGFR—21, pp 224-234) **Investigation of added masses and damping factors for vibrations of tube and tube bundles in fluid.** Sinyavskii, V.F.; Fedotovskii, V.S.; Kukhtin, A.B. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

The vibrations of single cylinders in fluid being surrounded by the solid walls of different form as well as the bundles of cylindric rods have been considered in this report. A model of the hydrodynamic damping of vibrations and the analytic solution of a problem concerning the damping of cylinder vibrations in fluid surrounded by a concentric shell is proposed. The influence of fluid viscosity and vibration frequency on a value of the fluid added mass and the damping factor of vibrations is shown. For the cylinder being vibrated near the boundaries of a special type (for example, a flat wall, a plane gap) and for the cophased vibrations of some triangular and square packed rod bundles there have been carried out the calculations for the added masses and the damping factors by an electrodynamic analogy method. The calculational results are compared with the available experimental data. A satisfactory agreement between the experimental data and the calculational results indicates the possibility for practical using the suggested procedure and the calculational formulae for determining the natural frequencies and the damping factors of vibrations for elastic cylindrical elements in different fluids.

50093 (IWGFR—21) **Specialists meeting on LMFBR flow induced vibrations.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). Dec 1977. 237p. (CONF-770933—). Dep. NTIS, PC A11/MF A01.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

Separate abstracts were prepared for each of the individual papers included.

50094 (IWGFR—21, pp 7-26) **Fast reactor flow induced vibration with particular reference to PFR and conceptual CDFR design.** Collinson, A.E. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

This paper describes development work and basic design criteria as applied to vibration induced by fluid flow for the United Kingdom LMFBR programme. Possible harmful effects that could result from excessive vibration levels are highlighted with the associated excitation mechanisms. Instances of flow-induced vibration encountered in development models and in PFR are described. Basic design requirements and the overall philosophy are considered with respect to PFR and notional CDFRs. Ongoing research objectives are outlined giving some insight into the broad strategy involved. Finally, details are given concerning projects presently in progress along with more long term proposals.

50095 (IWGFR—21, pp 27-42) **Flow induced vibration studies for LMFBR in Japan: past and recent studies of FIV for JOYO and MONJU.** Sato, K. Dec 1977.

In Specialists meeting on LMFBR flow induced vibrations.

This paper presents the past and recent studies of flow induced vibration of the reactor components for the experimental fast breeder reactor JOYO and the prototype fast breeder reactor MONJU, in which many suggestive results for the higher flow velocity systems in a future reactor are contained. The fuel subassembly is the most important from the view point of the vibration. Thus, the studies were carried out with a mock-up subassembly for JOYO. In this experiment, statistical analysis results of the vibration characteristics of single core subassembly and the effects of external forced vibration, flow disturbance and fuel pin bundle vibration were reported. The further more detailed investigations are now being performed for MONJU. In addition to the above studies, the vibration failure of a sodium valve is reported. The valve is a 8-inch stop valve in sodium flow and heat transfer test loop at O-arai Engineering Center. The failure occurred in 1969 during the performance test of the mechanical pump, and this resulted in a small sodium leak. The cause of the failure was found to be the vibration fatigue of the metal bellows.

50096 (IWGFR—21, pp 43-50) **Vibration measurements and analysis for the reactor vessel and internals of the SNR-300.** Schmidt, H. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

During normal operation the SNR-300 LMFBR power plant has a well defined coolant flow distribution with a moderate velocity level. The flow induced vibration potential is therefore very low. Nevertheless much effort has been devoted to study the vibrational behaviour of the reactor internals and the vessel structure. In recent years a number of flow vibration tests in water loops and perform-

ance tests in sodium have been conducted with SNR fuel assemblies. Although some uncertainty will remain due to the reactor environment, the experimental evidence from these tests indicates that flow induced vibration in SNR-300 fuel assemblies will be insignificant. In order to meet the licensing conditions for securing the integrity of the internals, an iterative procedure is planned, consisting of theoretical and experimental structure analysis and a final vibration measurement during reactor commissioning. First results are presented.

50097 (IWGFR—21, pp 51-62) **Substantiation of vibration strength of nuclear reactor and steam generator internals; main problems.** Fyodorov, V.G.; Sinyavsky, V.F. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

The report details the scope and priority of studies necessary for substantiation of vibration strength of steam generator tube bundles and reactor fuel assemblies, and design modifications helping to reduce flow-induced vibration of the internals specified. Steam generator tube bundles are studied on the basis of a standard establishing vibration requirements at various stages of design, manufacture and operation of a steam generator at a nuclear power station. The main vibration characteristics of tubes obtained through model and full-scale tests are compared with calculation results. Results are provided concerning test-stand vibration tests of fuel elements and fuel assemblies.

50098 (IWGFR—21, pp 63-70) **Fuel element vibrations in a fast reactor core due to sodium flow.** Teulon, J.; Simonneau, J.P.; Brenir, Y. Dec 1977. (In French).

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

In a fast neutron reactor, the fluid reaches the highest speeds in the core. Very turbulent, the resulting excitation incites the core elements to vibrate. A knowledge of the relative amplitudes and relative lengthening attained is necessary for the evaluation of the damage which could ultimately be produced. These vibration studies are carried out at the CADARACHE Nuclear Center of the totality of the assemblies and on the constituents of these assemblies. Concurrently, an analysis of the fluctuating pressures in the fluid is carried out.

50099 (IWGFR—21, pp 99-110) **Flow induced vibration of the large-sized sodium valve for MONJU.** Sato, K. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

Measurements have been made on the hydraulic characteristics of the large-sized sodium valves in the hydraulic simulation test loop with water as fluid. The following three prototype sodium valves were tested: (1) 22-inch wedge gate type isolation valve, (2) 22-inch butterfly type isolation valve, and (3) 16-inch butterfly type control valve. In the test, accelerations of flow induced vibrations were measured as a function of flow velocity and disk position. The excitation mechanism of the vibrations is not fully interpreted in these tests due to the complexity of the phenomena, but the experimental results suggest that it closely depends on random pressure fluctuations near the valve disk and flow separation at the contracted cross section between the valve seat and the disk. The intensity of flow induced vibrations suddenly increases at a certain critical condition, which depends on the type of valve and is proportional to fluid velocity.

50100 (IWGFR—21, pp 111-114) **Heat exchanger vibration.** Richards, D.J.W. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

The heat exchangers of various types are common items of plant in the generation and transmission of electricity. The amount of attention given to the flow-induced vibrations of heat exchangers by designers is usually related to the operational history of similar items of plant. Consequently, if a particular design procedure yields items of plant which behave in a satisfactory manner during their operational life, there is little incentive to improve or refine the design procedure. On the other hand, failures of heat exchangers clearly indicate deficiencies in the design procedures or in the data available to the designer. When such failures are attributable to flow-induced vibrations, the identification of the mechanisms involved is a prime importance. Ideally, basic research work provides the background understanding and the techniques necessary to be able to identify the important mechanisms. In practice, the investigation of a flow-induced vibration problem may identify the presence of mechanisms but may not be able to quantify their effects adequately. In these circumstances the need for additional research work is established and the objectives of the research programme emerge. The purpose of this paper is to outline the background to the current research programme at C.E.R.L. on heat exchanger vibration.

50101 (IWGFR—21, pp 115-122) **Flow induced vibration of secondary piping of LMFBR.** Gibert, R.J.; Axisa, F. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

This paper presents a method for evaluating the characteristics of vibrations caused by internal flow in three-dimensional piping systems conveying high density fluids. The excitation of the circuit is mainly caused by the flow singularities, and it is shown that the problem may be reduced to calculate the response of the circuit to an acoustical pressure discontinuity, localised at each flow singularity. The theoretical formulation of the coupled acoustical-mechanical problem and to its numerical solution by the computer code TEDEL is discussed. An experimental test of the method is described. The tested piping system consists of a stainless steel tube circuit comprising four 90° bends, conveying water. Vibrations are excited by a half closed gate valve. Satisfactory results are obtained concerning both the frequencies of resonance of the circuit and the level of the vibrations observed.

50102 **Birth of the breeder.** Forrest, J.S. (ed.). Edinburgh; Scottish Academic Press (1977). vp. (CONF-7703103—).

From Meeting on the breeder reactor; Strathclyde, UK (25 Mar 1977).

Papers on FBR type reactors are presented.Vanadium single crystals derived from alumothermic (98.5%) and electrolytic (99.9%) material by growing using electron crucible-free zone melting at different zone travel rates with the growth axis being oriented along $< 001 >$, $< 110 >$ and $< 111 >$ been analyzed by roetgenographic technique. The $< 110 >$ crystals from alumothermic vanadium have a critical growth rate of 1.5 mm/min, those from electrolytic one, 6-7 mm/min. The experiments indicate that $< 001 >$ ot $< 111 >$ oriented crystals can not be made defect-free even at infinitely low growth rates; the imperfection factor for these crystals approaches 0.007-0.009. Growth rate has the greatest effect on the perfection of crystals grown from alumothermic material. It follows from the present data that the most favourable orientation for manufacturing perfect crystals at slow growth rates is the $< 110 >$ direction.

50103 (ZfK—344) **Sodium boiling experiment in the reactor BOR-60.** Afanasiev, V.A.; Mitenkov, F.M.; Fuge, R. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Oct 1977. 9p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Sodium boiling was generated in the BOR-60 core by γ-heating of a tungsten rod bundle in a special test assembly. The principal possibility of boiling detection by acoustic and neutron noise was shown. Some results of spectrum and correlation analysis are presented and the necessity for tailored signal evaluation methods in order to increase the reliability of boiling detection is pointed out.

50104 **Comparison of economic performance of LMFBR and GCFR radial blankets.** Jankhah, M.H.; Tsoulfanidis, N. (Univ. of Missouri, Rolla). *Trans. Am. Nucl. Soc.;* **28**: 384-385(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50105 **Interpretation of the isotopic breeding worth.** Hanan, N.A.; Borg, R.C.; Ott, K.O. (Purdue Univ., West Lafayette, IN). *Trans. Am. Nucl. Soc.;* **28**: 386-388(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50106 **Consideration of fuel motion potential due to volatilization of metallic fission product inclusions.** Sasa, P. (Univ. of New Mexico, Albuquerque); Cronenberg, A.; Stevenson, M.G. *Trans. Am. Nucl. Soc.;* **28**: 426-428(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50107 **Vibration studies of perforated plates on CRBRP mixing-tee model.** Chung, H.; Halle, H. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 434-435(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50108 LMFBR refueling force limits criteria, testing, and evaluation. Fox, J.N. (General Electric Co., Sunnyvale, CA). *Trans. Am. Nucl. Soc.;* **28**: 698(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50109 Sensitivity analyses of fast reactor systems including thorium and uranium. Marable, J.H.; Weisbin, C.R. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 718-719(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50110 Fast molten chloride reactor on the thorium cycle. Ottewitte, E.H. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 725-726(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50111 Calculational model used for the nuclear analysis of LWBR. Freeman, L.B. (Westinghouse Electric Corp., West Mifflin, PA). *Trans. Am. Nucl. Soc.;* **28**: 731-733(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50112 Expected nuclear performance and initial physics test results for the LWBR at Shippingport. Natelson, M.; Doub, W.B.; Eckert, R.J.; Freeman, L.B.; Hartfield, G.L.; Hecker, H.C.; Sarber, W.K. (Westinghouse Electric Corp., West Mifflin, PA). *Trans. Am. Nucl. Soc.;* **28**: 733-734(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50113 Evaluation of a variational method for estimation of neutron detection efficiency. Loyd, D.L. (Univ. of Tennessee, Knoxville); Robinson, J.C.; Selby, D.L. *Trans. Am. Nucl. Soc.;* **28**: 773-774(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50114 Analysis of three-dimensional, hexagonal-Z systems using THREETRAN (hex,z). O'Dell, R.D.; Walters, W.F. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 776-777(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50115 Integral alpha and point conversion ratio measurements in advanced fuels critical assemblies. Bretscher, M.M.; Morman, J.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 783-785(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50116 Axial UO_2 blanket measurements in a rodded GCFR lattice. McCombie, C.; Gmuer, K.; Graf, H.; Richmond, R.; Schmocker, U.; Jermann, M.; Seth, S. (Swiss Federal Inst. of Reactor Research, Wuerenlingen). *Trans. Am. Nucl. Soc.;* **28**: 788-789(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50117 Procedures for measuring bowing/expansion reactivity parameters in an LMFBR. Fox, J.N. (General Electric Co., Sunnyvale, CA). *Trans. Am. Nucl. Soc.;* **28**: 789-790(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50118 (IAEA-CN—36/356) USSR fast reactor development program and its current state. Kazachkovski, O.D.; Meshkov, A.G.; Mitenkov, F.M. Apr 1978. Translation of USSR paper, 1977. (CONF-770505—190(Trans.)). 24p. Dep. NTIS, PC A01/MF A01.

From International conference on nuclear power and its fuel cycles; Salzburg, Austria (2 May 1977).

Fast power reactors make it possible to use in a more efficient way existing natural resources of nuclear raw materials, ensuring by that large-scale development of nuclear power. The state of fast reactor development work in the USSR and some questions of fuel cycle are discussed.

50119 Growth of a sodium vapour bubble rising in the superheated liquid. Shah, V.L. (Wisconsin Univ., Milwaukee (USA)); Sha, W.T. (Argonne National Lab., Ill. (USA)). *Nucl. Eng. Des.;* **45**: No. 1, 81-91(Jan 1978).

The growth of a single spherical bubble moving in a uniformly superheated liquid is considered. The equations of motion and energy are presented in the forms which take into consideration the interaction between the motion and the growth. The fourth order Runge-Kutta method is used to obtain a simultaneous solution of equations of motion and growth rate. The solution is compared with the available experimental results. The results for liquid sodium are presented for a range of pressures and Jakob numbers.

50120 Transfer function of temperature fluctuations for liquid metal slug flow. Bunschi, J. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Reaktortechnik). *Atomkernenergie;* **31**: No. 1, 23-27(1978).

The axial transport of temperature fluctuations in vertical slug flow is investigated. The behaviour of the temperature fluctuations in the high frequency range is well described only if heat conduction as a dissipation mechanism is taken into account. In the case of high thermal conductivity of the fluid a simple approximation for the transfer function of temperature fluctuations is found. Its form explains why the fluid velocity may be derived from the peak of temperature cross-correlation functions. Numerical results for the transfer function are given for liquid sodium. The influence of the axial conduction on the determination of heat transfer coefficienty from temperature transfer functions is discussed.

50121 Improvements in or relating to the blocking of micropores in a structure. Halstead, W.D. (to Central Electricity Generating Board, London (UK)). British Patent 1,495,561/A/. 21 Dec 1977. 6p.

A method is described for blocking micropores that may occur during the manufacture of a sodium-water heat exchanger. Such pores may be so fine, say 10^{-2}mm diameter or less, that they escape detection during testing. One face of the members to be treated is exposed to vapour phase Ni carbonyl, oxide, or hydroxide, whilst the other face is exposed to a suitable reactant that causes deposition of Ni or an oxide thereof in the micropores. If an oxide is deposited this is subsequently reduced to Ni by passing a reducing gas over the face that is to be exposed to Na.

50122 Heat exchangers. Hayden, O.; Willby, C.R. (to UKAEA London Office). British Patent 1,495,654/A/. 21 Dec 1977. 4p.

Reference is made to "tube-in-shell" heat exchangers. Hitherto it has been the practice to seal the tubes to a tube sheet by welding, but frequently the welds fail, probably as a result of stress corrosion, and repair is a very difficult operation because there are so many closely spaced tubes. In the arrangement described welding is avoided by employing what are known as compression pipe couplings, the construction of which is described. The arrangement is particularly applicable to liquid metal cooled reactors.

50123 Discussion of the ERDA breeder program in the USA. Critical survey of the related proliferation problems. Kessler, G. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Schneller Brueter). *Atomwirtsch., Atomtech.;* **22**: No. 12, 643-648(Dec 1977). (In German).

The ERDA breeder program in the United States has been drastically cut back by the Carter Administration. Because of its large reserves of uranium and coal the U.S. feels it is able to postpone considerably the development of commercial fast breeder power plants. This policy is also very much a consequence of the proliferation threat emphasized by the Carter Administration in connection with reprocessing and a plutonium economy. For the same reason, also the other industrialized nations have been requested to rearrange their fast breeder activities accordingly. However, the situation with respect to reserves of primary energy in the German Federal Republic, in the whole of Western Europe and also in Japan compels these countries to make provision for reprocessing spent nuclear fuels, using plutonium as a nuclear fuel and last but not least, the determined development of commercial LMFBR power plants. In addition, an argument used against the new American nuclear policy, both in the United States and in other industrialized countries, is the contention that there is no such thing as an absolutely proliferation-proof fuel cycle and that this objective could not even be attained by a halt to fast breeder development.

50124 Improvements in or relating to sensors for monitoring the electrical conductivity of electrically conductive fluids. McCann, J.D.; Poole, M.J. (to UKAEA). British Patent 1,491,207/A/. 9 Nov 1977. 12p.

A sensor is described that is suitable for monitoring the temperature of the coolant of a liquid metal cooled nuclear reactor or at least variations of the temperature of such a coolant from a predetermined value before it leaves the confines of a fuel subassembly and mixes with the outlet streams of other sub-assemblies. The sensor may also be used to detect fluctuations in the flow rate of the coolant. The basis of its action is changes of the electrical conductivity of the coolant with temperature. Constructional details are given. It is pointed out that random mixing of a number of coolant streams at slightly different temperatures produces temperature fluctuations about a mean value and this gives rise to a fluctuating signal sometimes referred to as 'fuel temperature noise', and it is believed that blockage of one coolant stream has a greater relative effect on this fluctuating signal than one on the mean outlet temperature of the coolant stream. Advantages of this type of sensor over conventional thermocouples are stated.

50125 Transient xenon analysis in a molten salt breeder reactor. Shimazu, Y. (Mitsubishi At Power Ind, Inc, Tokyo, Jpn). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 11, 805-810(Nov 1977).

An evaluation is made to estimate the transient xenon behavior in an MSBR for several representative patterns of operation. Such analysis is indispensable for detailed evaluation of reactivity balance under transient conditions. The results are compared with those of a typical PWR. The xenon behavior does not differ between the two types of reactor to the extent that might be expected from the fact that in the MSBR, xenon behavior is additionally conditioned by the process of migration into the circulating bubbles and into the graphite, as well as by diffusion therein. It is shown that the reactivity transients due to xenon buildup can be held within the range of counteraction by control rod movement for any normal change of reactor output, so long as the reactor is not shut down. After a shutdown, insertion of the control rods will not suffice to override the xenon buildup, but then the fuel processing system could be conveniently utilized to increase the quantity of $sup 233$U contained in the fuel and regain required reactivity of the core. 6 refs.

50126 Liquid metal cooled nuclear reactors. Barnes, S.; Fothergill, J.R. (to UKAEA). British Patent 1,488,478/A/. 12 Oct 1977. 6p.

Reference is made to liquid metal cooled nuclear reactors of the 'pool' type. In such reactors the core, the heat exchangers, and the coolant circulating pumps are submerged in a pool of liquid metal. In operation of the reactor it is necessary to be able to locate and identify components submerged in the pool, and before moving rotating shields in the roof of the pool-containing vault it is necessary to ensure that all the normally suspended absorber rods have been inserted in the core and released from their suspensions. Television cameras are unsuitable for use in the opaque liquid metal but ultrasound in the megahertz range has been used to give a television screen kind of display. There is some difficulty, however, in transmitting ultrasound signals from a transducer into the pool of coolant because the transducer must be protected from the high temperature environment of the coolant. This difficulty has been partially overcome, however, by transmitting the signals by way of a wave guide extending from the transducer into the coolant pool. Such a wave guide may comprise a column of liquid metal within a dip tube. The column of liquid coolant is uninterrupted by a supporting diaphragm. Such a system is here described.

50127 Circumferential nonuniformity of cladding radiation swelling of fast reactor peripheral fuel elements. Reutov, V.F.; Farkhutdinov, K.G. *At. Energ. (USSR);* **43**: No. 1, 12-15(Jul 1977). (In Russian).

The results are presented of the investigation into the perimeter radiation swelling of Kh18N10T stainless steel cladding in different cross sections of a peripheral fuel element of the BR-5 reactor. The fluence on the cladding is 1.8-2.9 x 10^{22} fast neutr/cm^2, the operating temperatures in different parts of the fuel element being 430 deg to 585 deg C. There has been observed circumferential non-uniformity of the distribution, concentration, and of the total volume of radiation cavities, which is due to temperature nonuniformity along the cladding perimeter. It is shown that such nonuniformity of radiation swelling of the cladding material may result in bending of the peripheral fuel element with regard to the fuel assembly sheath walls.

50128 Irradiation behaviour of carbide fuel elements in the BOR-60 breeder reactor. Tsykanov, V.A.; Gryazev, V.M.; Davydov, E.F.; Kuz'min, V.I. (and others). *At. Energ. (USSR);* **42**: No. 5, 378-382(May 1977). (In Russian).

The results of an investigation of irradiation behaviour of uranium carbide fuel elements in the BOR-60 reactor up to burnups of 10 per cent fima are presented. The fuel elements and fuel assemblies characteristics, as well as the irradiation history are shortly described. The most stringent irradiation mode was as follows: neutron fluence of 6 x 10^{22} neutr/cm^2 (E>0.1 MeV), linear power density of 700 W/cm, fuel cladding temperature of 680 deg C. The axial core distribution as well as dependency of geometrical parameters of the stainlness steel fuel cladding on fuel burnup and density were measured. To attain zero plastic deformation of the fuel cladding, total volume of voids in the fuel, and a radial gap between the fuel pellets and the cladding is indicated to be 20 per cent. The average rates of fuel swelling at fuel element core temperatures about 1200 +- 50 deg C were measured to be equal to 1.5 +- 0.2 per 1 per cent of burnup with respect to density variations. Good compatibility between the fuel and the cladding is underlined.

50129 Magnetostrictive probe. Knaak, J. (to Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). German(FRG) Patent 2,541,530/A/. 31 Mar 1977. 11p. (In German).

The probe consists of a rod-shaped magnetostrictive material with two coils axially wound around it. One coil serves as a measuring coil whenever pressure is applied axially on the rod, the other coil is for premagnetisation of the rod. The front end of the rod is connected via bellows to a diaphragm, this constitutes the front part of the cylindrical probe-housing. The back end of the rod is connected to the housing by a sound-absorbing material. The device is used as a sound sensor, for example in the liquid sodium cooling circuit of a nuclear reactor.

50130 Azimuthal non-uniformities of temperature of fuel elements arranged in regular lattices for turbulent liquid metal flow. Ushakov, P.A.; Zhukov, A.V.; Matyukhin, N.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). *Teplofiz. Vys. Temp.;* **15**: No. 1, 76-83(1977). (In Russian).

Three methods for semiempirical solution of the problem on nonuniformity of the temperature of fuel elements in regular lattices are considered. An analytical solution based on the hypothesis of analogy of the local heat transfer coefficients with those in equivalent parallel-sided slits is obtained. Another solution is also obtained, with the use of the universal temperature profile in a round pipe. It is believed that the solution in which a temperature profile for a "rod" flow is used for estimating azimuthal, heat flux in the coolant is the principal one. On the basis of an analysis of calculated and experimental data, a simple approximation formula for calculating nonuniformities in fuel element temperature is recommended.

50131 Flowsheet and technical data of the KNK-II reactor. Artz, D. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projektbereich Kompakte Natriumgekuehlte Kernreaktoranlage). *KFK Nachr.;* **9**: No. 3, . 68-69(1977). (In German).

DIncluded are data on the reactor vessel, the reactor closure head, the core, fuel elements, the primary and secondary loop, and other components of the KNK-II reactor.

50132 Layout of the KNK-II core elements. Dietz, W.; Duenner, P.; Mayer, H.; Steinmetz, B.; Toebbe, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). *KFK Nachr.;* **9**: No. 3, . 12-13(1977). (In German).

The following three criteria may be summarized as the main boundary conditions for the design of the KNK-II core elements: - Representative operational loads of the fuel rods, absorber rods, and structural parts of core elements. - Validation and extension of the knowledge on material behaviour under reactor operating conditions. - High safety standard against an exceeding of core element failure limits with a view to undisturbed operation of the core elements in the KNK-II.

50133 Layout of the KNK-II reactor core. Henssen, H.; Feltes, W.; Heinecke, J.; Ricken, E.; Wilhelm, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). *KFK Nachr.;* **9**: No. 3, . 10-11(1977). (In German).

Converting the KNK reactor into a test bed for fast breeder elements included the difficult core design problem of providing satisfactory test conditions under the boundary conditions given by the plant. These are: 1) The possibility of inserting a statistically significant number of breeder rods in SNR-type fuel rods. 2) The use of breeder fuels in the test elements. 3) Reaching representative linear specific powers (max. 435 W/cm). 4) Satisfactory residence times (maximum burn-up 80,000 MWd/t), i.e. sufficient excess reactivity. 5) Achieving a breeder-like neutron spectrum.

50134 Handling system. Vogt, F.; Erdmann, W.; Katzmann, H.; Menck, J. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)); Breitlaender, H.; Reuter, B. (Kernkraftwerk-Betriebsgesellschaft m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)). *KFK Nachr.;* **9**: No. 3, . 28-29(1977). (In German).

Core layout, optimisation of the handling system, i.e. fuel element storage, neutron source shielding, and its effects on radiation exposure are discussed.

50135 Emergency cooling system of the KNK-II reactor. Vossebrecker, H.; Bange, F.J.; Dreyer, S.; Groenefeld, G.; Meyer, P.; Schwarzin, K. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). *KFK Nachr.;* **9**: No. 3, . 26-27(1977). (In German).

After a general description of the emergency cooling system for the reactor vessel, thermodynamic calculations, incorporation of existing part systems in the emergency cooling system, power supply, and the monitoring of the system are discussed.

50136 Valves for the sodium-cooled fast breeder KKW Kalkar (SNR 300). Wuellner, G.; Helbig, D. *Three R Int.;* **16**: No. 8, 464-469(1977). (In German).

Valves for controlling the flow of liquid sodium are located in exposed positions. Exacting demands are imposed on the tightness of the pressure vessel and the proper functioning of all components in long-term operation. Valve design was re-examined by stress analysis using finite elements in order to determine what stresses the valves are subjected to as a result of temperature shocks. The bellows valves demonstrated their ability to function properly in prolonged tests under actual service conditions.

50137 (EURFNR—1435) **Fast Breeder Project. Quarterly report, 1977.** Hueper, R. (comp.). (Kernforschungszentrum Karlsruhe (Germany, F.R.)). 1977. Translation by T.J. Clark of KFK—1277/1. 176p. Dep. NTIS, PC A09/MF A01.

Work performed within the framework of the Fast Breeder Project at Kernforschungszentrum Karlsruhe during the first quarter of 1977 is described. The work included fuel rod development, materials studies, physics, safety, and sodium technology.

50138 Spatio energetic sensitivity of the equivalent thermal flux on the intermediate heat exchanger of a typical fast breeder reactor. Boioli, A.; Fiorini, L.; Moreau, J.; Suntinger, G. (CEN, Cadarache, France). pp 132-139 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

The calculation of the thermal equivalent flux on the intermediate heat exchanger is the main problem of a pool type LMFBR Shielding. The present paper is related to a reactor which lateral shielding consists of a sodium-stainless steel mixture. The following problems are treated: Slowing down of neutrons (studied with "Channel Theory"), Sensitivity of the thermal flux on the heat exchanger to the following parameters: stainless steel and sodium total cross section, Legendre polynomial expansion. Some ways for shielding optimizations can be deduced from calculations performed with ANISN and SWANLAKE: use of moderator, local shielding, stainless steel volumetric percentage variable along the lateral shield. Finally, we give an estimate of thickness increase which results from multigroup cross section uncertainties.

50139 Irradiation effects and design of LMFBR permanent reactor structures. Blackburn, L.D.; Knecht, R.L. (Westinghouse Hanford Co., Richland, WA). pp 230-237 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

Current approaches to the design of permanent reactor structures for LMFBRs emphasize the restriction of neutron radiation exposure to levels which do not grossly alter the mechanical behavior of the materials of construction. Conventional quantitative design procedures can then be employed to limit calculated stresses to acceptable values. The decrease in material ductility with irradiation has generally been used as a criterion for limiting neutron exposure, and experimental results are examined in the light of establishing such limits. When radiation exposure must exceed the established limits, the properties of irradiated material must be used to modify design allowable stress intensity values and creep-fatigue interaction. Fracture mechanics analyses are also a potentially important feature of the design procedure in this regime. Irradiation-induced swelling and creep effects also should be accounted for in the design. Several examples of relevant property changes are reviewed.

50140 Neutron transport through straight and once bent sodium pipe in shielding of fast reactor. Burian, J. (Nuclear Research Inst., Rez, Czechoslovakia); Jansky, B.; Osmera, B.; Otopal, P.; Rataj, J.; Petrov, E.; Trykov, L.; Nikolajev, A.; Semenov, V. pp 246-252 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

The paper presents measurements and calculations on the neutron attenuation along 40 cm diameter straight and bent sodium pipe. The following types of spectrometers were used in measurements on VVR-S reactor: stilbene scintillator, proportional hydrogen counter, multisphere technique and activation foils. Discrete ordinates and Monte Carlo methods were used to study this type of problem.

50141 Study of fast neutron streaming through the core support-plate shield of a LMFBR. Suzuki, I. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Oka, Y.; Wakabayashi, H.; An, S.; Sasaki, K.; Miyasaka, S.; Inoue, T. pp 271-279 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

The paper presents measurements and calculations for the fast neutron streaming through the core support plate shield of a LMFBR. Experiment was performed in the vertical column of YAYOI, the fast-neutron source reactor at University of Tokyo. The results are arranged in the form of the attenuation factor of the shields which have three types of coolant holes. Two and three dimensional calculations were carried out. The results are compared with experimental ones.

50142 Reactor vessel. Wade, E.E. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Swedish Patent 2,555,270/A/. 8 Jul 1976. 17p. (In German).

In the case of reactor vessels, especially in that of LMFBR type reactors, difficulties arise in lubricating the bearings and seals for the ducts in the top of the vessel. According to the invention, this is to be avoided by special supporting members which receive the rotatable parts of the cover and the design of which prevents the lubrication from entering into the inner part of the reactor.

REGULATION AND LICENSING

50143 (SINDOC—77-91) **Regulatory inspection of nuclear power plants in NEA member countries.** Gronow, W.S.; Ilani, O. (Nuclear Energy Agency, 75 - Paris (France)). 1977. 20p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The increasing use of nuclear power and public interest in the safety controls led to the proposal by the sub-Committe on Licensing of the NEA Committee on the Safety of Nuclear Installations for a specialist meeting on regulatory inspection practices. This report which was prepared at the request of the sub-Committee to assist in the exchange of views and experience at the meeting reviews the response to a questionnaire on the systems employed, the scope and objectives and the effort involved in regulatory inspection throughout all stages of the life of a nuclear power plant. Other aspects of regulatory inspection activities are discussed including documentation, procedures for changes in technical specification and modifications to plant, powers and duties of regulatory inspection personnel and actions to be taken in the event of an accident or emergency. The report concludes with some comments on those aspects of regulatory inspection practices where further information and an exchange of experience might prove to be beneficial to Member countries.

50144 Mitigating the economical and operational impact of 10CFR73.55. Garrett, R.E. (Florida Power and Light Co., Miami). *Trans. Am. Nucl. Soc.;* **28**: 681(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50145 Current environmental issues in power plant licensing. Ballard, R.L. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.;* **28**: 682(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50146 Some frustrations of environmental red tape. McClusky, J.P. (Commonwealth Edison Co., Chicago). *Trans. Am. Nucl. Soc.;* **28**: 683(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50147 Participation of private associations in the nuclear licensing procedure under the Atomic Energy Act. Concerning the question of participation of joint private associations in administrative and legal administrative procedures. Wagner, H.; Krech, H. *Atomwirtsch., Atomtech.;* **23**: No. 1, 18-22(Jan 1978). (In German).

The creation of a special right of action for associations in licensing procedures under the Atomic Energy Act is not only requested by organizations fighting against the use of nuclear energy in the Federal Republic, but is also under examination by the Government. The authors investigate both the legal chances for such actions brought by associations and the need for them, especially under the aspect of the requirement for legal protection. They arrive at the conclusion that there are no compelling reasons for a special legal instrument regulating the participation of associations in administrative procedures and legal administrative procedures above and beyond the rules already existing. Members of associations, for instance, are free to raise objections in administrative procedures and, in doing so, to be represented by the agents of associations. Moreover, there has not been one nuclear power plant project so far against which a member of an association would have been barred from bringing action.

50148 International legal perspective on the conduct of abnormally dangerous activities in frontier areas: the case of nuclear power plant siting. Handl, G. (Univ. of Tulsa College of Law, AZ). *Ecol. Law Q.;* **7**: No. 1, 1-50(1978).

The question is examined of whether it is permissible under international law to site nuclear facilities imposing a risk on a neighboring state where benefits to the risk-exposed state are either non-existent or unacceptable because of the associated risks.

50149 Sword of Damocles, or: the fast breeder in Kalkar and the Higher Administrative Court at Muenster. Dreistern. *Energie;* **29**: No. 10, 307-309(Oct 1977). (In German).

A decision of the OVG Muenster of August 18th, 1977 has made the headlines. The judges of Muenster have put the question to the Federal Administrative Court, whether section 7 of the Atomic Energy Act is in agreement with the consitution as far as the licensing of fast breeders is concerned. A technician comments on the explanations of the OVG judges in a press conference as regards their decision.

50150 Popular participation and public hearing by construction of nuclear power plants. Hokimoto, I. (Kokugakuin Univ. (Japan)). *Genshiryoku Kogyo;* **23**: No. 7, 21-27(Jul 1977). (In Japanese).

One of the urgent problems now confronting the atomic power development is to search a legal measure for obtaining the public acceptance with the premise of understanding and cooperation, and it is discussed. Attention is paid to the present status of Japan, in which the legal system is incomplete, and the administrative process unspecified in laws and ordinances must be considered seriously. The first section deals with the public hearing and its problems concerning the installation of reactors. The list of twelve main problems that were pointed out in the manual of holding the public hearing by the council of Japanese scientists is given.

50151 Expert opinions on the plant. Fendler, H.G.; Bosten, F.; Jurgutat, H.; Morgner, E. *KFK Nachr.;* **9**: No. 3, . 38-39(1977). (In German).

Appraisal of the site, building construction, start-up and operation due to the 'essential changes' according to the article 7 of the Atomic Energy Act (fast core, plutonium fuel elements).

50152 Press report by the Higher Administrative Court in Lueneburg on October 17, 1977 concerning the proceedings in the case of the Brokdorf reactor building-stop. *GRS Kurz-Inf., Reihe B;* No. 27, 1(1977). (In German).

Construction work on the reactor may only begin after an application ready for examination has been required for an intermediate depot for spent fuel elements and after geological tests have been initiated for the proof of the suitability of a certain site for the ultimate storage of radioactive wastes. The Court bases this decision, which was made in a suspension procedure and which has therefore only a temporary character, mainly on the stipulation in section 9a of the Atomic Energy Act, introduced just before the controversial partial construction licence was issued in the autumn of 1976. In this section the granting of further nuclear licences is made dependent on measures for creating facilities for the utilization and ultimate storage of radioactive substances to be taken in hand at the same time.

50153 Lecture (abridged version) on 'Nuclear law in the field of tension between technology and law'. Lukes, R. (Muenster Univ. (Germany, F.R.)). *At. Inf.;* No. 11, p. 8-9(1977). (In German).

The present problems in nuclear law are not just nuclear law problems but problems encountered in all fields of law concerning technical safety - those legal regulations determining the demands to be met by the properties and behaviour of production plants and products. At the moment, they are most striking in nuclear law, where they have the most far-reaching consequences for economic policy and the labour market. There are three kinds of considerations to be made in connection with the future development of technical safety legislation if this development is to achieve sufficient intensity of regulation and not to hinder technical progress. 1) Regulating technical facts by a number of unspecific legal terms. 2) Better concretisation in legal regulations of demands made on technical systems and their behaviour. 3) Possibly, establishment of 'subparliaments' of experts.

REACTOR DOCKETS

50154 (DOCKET-50010—959) **Dresden Nuclear Power Station, Units 1, 2, and 3. Annual operating report: January—December 1977.** (Commonwealth Edison Co., Chicago, Ill. (USA)). 24 Feb 1978. vp. (DOCKET-50237—1533; DOCKET-50249—1276).

After a summary of reactor operating experiences, data are presented concerning amendments to the operating licenses and technical specifications, changes, modifications, tests, experiments, and maintenance of safety-related equipment. (FS)

50155 (DOCKET-50344—696) **Trojan Nuclear Plant. Annual operating report: January—December 1977.** (Portland General Electric Co., Oreg. (USA)). [nd]. 174p. Dep. NTIS, PC A09;MF A01.

Trojan generated 28,791,044 MW hours of electricity, an output greater than any other commercial U.S. plant. Availability factor was 92.6 percent and the capacity factor was 68.6 percent. Data are presented concerning operations, maintenance, changes, tests, experiments, specifications, and modifications. Also reported are effluents, waste disposal, meteorology data, radiation doses, chemical uses, and environmental surveillance. (FS)

ECONOMICS

REFER ALSO TO CITATION(S) 50219

50156 USA faces the energy challenge. Carmoy, G. de (European Inst. of Business Administration, Fontainebleau (France)). *Energy Policy;* **6**: No. 1, 36-52(Mar 1978).

The position of nuclear power in the overall energy policy of the USA, as compared with other energy sources, is discussed in the light of consumption needs and reserves. The decline of the U.S. nuclear power industry and the International energy policy are examined. The economic, geopolitical and energy shortage risks associated with U.S. dependence on Middle East Oil are considered in relation to risks arising from the use of nuclear energy, in particular the risk of nuclear proliferation.

50157 Nuclear energy prospects. Jones, P.M.S. (UKAEA London Office). *Atom (London);* No. 256, 26-30(Feb 1978).

This paper by the Head of the Economics and Programmes Branch of the United Kingdom Atomic Energy Authority discusses the UK and world prospects for nuclear energy and concludes that there is no technical obstacle to its becoming the 'workhorse' both for the UK and the world. If the fast reactor programme is continued there is no reason why this situation should not persist through the greater part of the next century, backed up where appropriate by coal, gas and other energy sources. There is no energy barrier to continued growth and to progressive improvement of living standards, and given the political will and international co-operation the world could become an even better place in which to live. The paper includes an appraisal of the well publicised opposition that has arisen in the world questioning the wisdom of the widespread adoption of nuclear power, and also surveys pronouncements made in its favour.

50158 Energy options open to mankind beyond the turn of the century. Haefele, W. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). *J. Inst. Nucl. Eng.;* **19**: No. 1, 12-19(1978).

It is stated that the real potential of nuclear power becomes visible only when a long-range time horizon beyond the year 2000 is considered. A prudent assessment then requires consideration of not only the nuclear option but also other options that may be open beyond the year 2000. This involves a global consideration of future energy demands. Headings of the paper are as follows - Global energy demand; renewable energy resources; the long range options - the case of solar power; the long range options - the case of nuclear power; and the case of coal. It is concluded that the solar option and the nuclear option offer the opportunity for a practically unlimited supply of power for the world. Coal has the largest potential of all fossil resources and when strategically employed and combined with non-fossil process heat it could cater for transportation purposes for perhaps 200 years or more. All of this provides a fairly optimistic picture. 10 references.

50159 Present and future nuclear power financing schemes. Diel, R. (Dresdner Bank A.G., Duesseldorf (Germany, F.R.)). *Atomwirtsch., Atomtech.;* **22**: No. 12, 632-638(Dec 1977). (In German).

From Reactor congress 1977; Mannheim, Germany, F.R. (29 Mar - 1 Apr 1977).

The financial requirement for nuclear power plants in the Federal Republic of Germany for the period up until 1985 was estimated to run up to some DM 100 billion already in the Nuclear Energy Study published by the Dresdner Bank in 1974. This figure is not changed in any way by the reduction the nuclear power program has suffered in the meantime, because the lower requirement for investment capital is more than offset by the price increases that have occurred meanwhile. A capital requirement in the order of DM 100 billion raises major problems for the power producing industry and the banks which, however, are not going to hamper the further expansion of nuclear power, because new financing schemes have been specially developed for the nuclear field. They include financing by leasing, the use of funds from real estate credit institutions for long term financing, borrowing of long term funds in the Euro market, and financing through subsidiaries of the utilities. The new financing schemes also apply to the large financial requirement associated with the nuclear fuel cycle, waste management in particular. In this sector the utilities agree to bear the economic risk of the companies implementing the respective projects. Accordingly, financing will not entail any major difficulties. Another area of great importance is export financing. The German-Brazilian nuclear agreement is a model of this instrument.

50160 Determination of the thermal efficiency of a nuclear power station. Roegener, H.; Klobasa, F. *Brennst.-Waerme-Kraft;* **29**: No. 12, 469-471(Dec 1977). (In German).

The thermal efficiency of a nuclear power station may be determined by measurement, particularly simply, from an energy balance incorporating the whole power station. Thereby, only two energy flows of equal order of magnitude, i.a. the electrical output and the waste heat flow, and two energy flows which are smaller by several orders of magnitude, i.a. the energy flow of exhaust air and the rate of outside radiation, have to be measured. The practical application of this method in connection with an acception test is described.

50161 Problems of nuclear power. Schulten, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). *Elektrotech. Z., A;* **98**: No. 12, 813(Dec 1977). (In German).

A short survey of the panel discussion held on the occasion of the international energy congress (October 3 to 4, 1977) in Bonn is presented.

50162 Nuklear power in Sweden - policy and reality. Ekberg, G. (Sydsvenska Kraft AB, Malmoe (Sweden)). *VGB Kraftwerkstech.;* **57**: No. 11, 752-729(Nov 1977). (In German).

The paper deals with present day energy policy in Sweden following the change in Government in October 1976. Arguments based on technical and economic realism are contrasted with the present Swedish energy policy which is against nuclear power. Misunderstandings and transgressions of areas of political competence must be reduced and constructive co-operation between politicians and energy producing companies is essential to ensure Sweden's energy supplies.

50163 Nuclear power: appeals, memoranda - moratorium. *Energie;* **29**: No. 10, 310(Oct 1977). (In German).

50164 Aeusserungen des Bundesministers fuer Forschung und Technologie zur friedlichen Nutzung der Kernenergie und Fortschreibung des Energieprogramms durch die Bundesregierung. Grosse Anfrage der Abgeordneten. (Remarks of the Federal Minister for Research and Technology on the peaceful uses of nuclear energy and the continuation of the energy programme by the Federal government. Interpellation in parliament). Bonn-Bad Godesberg, Germany, F.R.; Heger (1977). 6p. (In German).

Questions to the Federal Government and to the Federal Ministry for Research and Technology concerning the governmental declaration of the Federal Chanceller, statements by the Federal Ministry for Research and Technology concerning the possibility of a moratorium for nuclear power plant construction, the updating of the energy programme, and conclusions to be drawn from the WAES study are discussed.

CONSTRUCTION AND OPERATION

50165 (NUREG—0030(Vol.1)(No.2)) **Nuclear power plants. Construction status report, data as of January 31, 1978.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Management and Program Analysis). Feb 1978. 223p. NTIS $10.00.

This management report is designed to provide the necessary information for monitoring the progress of construction of nuclear power plants. It provides data for synchronizing the licensing process with predicted fuel loading dates, as well as providing a central federal government report for commercial reactor construction. It utilizes data collected from the utilities sponsoring these projects and the Office of Inspection and Enforcement, NRC, and analyzed by the Office of Management Information and Program Control in the implementation of Management Information Systems. The status of the 93 plants authorized to engage in construction activities in Regions I thru V is summarized in this document. This total includes (10) plants with Limited Work Authorization Permits.

50166 (NUREG—0030(Vol.1)(No.3)) **Nuclear Power Plants. Construction status report, data as of February 28, 1978.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Management and Program Analysis). Mar 1978. 225p. NTIS $10.00.

Data on the construction status of nuclear power plants in the US as of February 28, 1978 are presented. The data include licensing activities affecting the construction as well as detailed information on construction activities and schedules.

FUEL CYCLE

REFER ALSO TO CITATION(S) 50008, 50050

50167 (ORNL/TM—6332) **Economics and utilization of thorium in nuclear reactors. Technical annexes 1 and 2.** (Resource Planning Associates, Inc., Cambridge, Mass. (USA)). May 1978. Contract W-7405-ENG-26. 200p. Dep. NTIS, PC A09/MF A01.

An assessment of the impact of utilizing the ^{233}U/thorium fuel cycle in the U.S. nuclear economy is strongly dependent upon several decisions involving nuclear energy policy. These decisions include: (1) to recycle or not recycle fissile material; (2) if fissile material is recycled, to recycle plutonium, ^{233}U, or both; and (3) to deploy or not to deploy advanced reactor designs such as Fast Breeder Reactors (FBR's), High Temperature Gas Reactors (HTGR's), and Canadian Deuterium Uranium Reactors (CANDU's). This report examines the role of thorium in the context of the above policy decisions while focusing special attention on economics and resource utilization.

50168 Planning and scheduling for the refueling outage: problems of flexibility. Butterfield, L.D. (Commonwealth Edison Co., Chicago). *Trans. Am. Nucl. Soc.;* **28**: 309(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50169 Utility/fuel supplier relationships in 1985: supplier's view. Egan, M.R. (General Electric Co., San Jose, CA). *Trans. Am. Nucl. Soc.;* **28**: 316-317(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50170 1985 utility/vendor relationship. Snead, H.T. (Duke Power Co., Charlotte, NC). *Trans. Am. Nucl. Soc.;* **28**: 317(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50171 Impact of R and D on the 1985 fuel cycle. Zebroski, E.L. (Electric Power Research Inst., Palo Alto, CA). *Trans. Am. Nucl. Soc.;* **28**: 317-318(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50172 Overview of the thorium fuel cycle. Kasten, P.R. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 336(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50173 Toward an integrated reactor systems fuel strategy. Brogli, R.H.; Hamilton, C.J.; Ligon, D.M.; Turner, R.F. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **28**: 378-379(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50174 Versatile model for economic analysis of the nuclear fuel cycle. White, W. (Burns and Roe, Inc., Paramus, NJ). *Trans. Am. Nucl. Soc.;* **28**: 380-381(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50175 Ore price escalation in fuel cycle economic analyses. Ghahramani, K.; Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge). *Trans. Am. Nucl. Soc.;* **28**: 383-384(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50176 Fuel cycle cost sensitivity analysis for LWRs utilizing thorium. Parvez, A.; Becker, M.; Harris, D.R.; Quan, B. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **28**: 385-386(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50177 Measurements of transuranium concentrations in solid radioactive waste from seven commercial power reactors. Cline, J.E. (Science Applications, Inc., Rockville, MD); Hetzer, D.C.; Lapides, M.E. *Trans. Am. Nucl. Soc.;* **28**: 707-708(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50178 Benchmarking of CASMO against the Oskarshamn I BWR with Gd-loaded fuel. Edenius, M.; Wiksell, G. (Oskarshamnverkets Kraftgrupp AB, Stockholm). *Trans. Am. Nucl. Soc.;* **28**: 794-795(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50179 Report on the international conference on nuclear energy and its fuel cycle. Pt. 2. Technical sessions. Schwarz, E.R. (Energie-Versorgung Schwaben A.G., Stuttgart (Germany, F.R.)). *At. Strom;* **23**: No. 6, 149-161(Nov 1977). (In German).

From International conference on nuclear power and its fuel cycle (commemorating the 20. anniversary of IAEA); Salzburg, Austria (2 - 13 May 1977).

The author reports on the technical meetings at the international conference on Nuclear Energy and its fuel cycle in Salzburg from the 2nd to the 13th May 1977 in so far as they are of importance for the fuel cycle in the German Federal Republic.

50180 Some development problems with nuclear power plants in connection with optimal nuclear fuel utilization. Levai, A. *Arch. Energiewirtsch.;* **31**: No. 10, 839-843(Oct 1977). (In German).

The main problems of nuclear fuel supply in a system of thermal reactors and fast breeders are discussed. It is shown which influence the early or later application of fast breeders on uranium requirements has. However, a significant influence on, or assurance of, energy supply until the operation of thermo-nuclear power stations is only possible with improved breeding reactors (e.g. decrease in doubling time).

PROCESS HEAT REACTORS

50181 Constitutional questions of the decision of the OVG Muenster concerning the Kalkar proceedings. Backhaus, L. (Muenster Univ. (Germany, F.R.). Rechtswissenschaftliches Seminar). *Energiewirtsch. Tagesfragen;* **27**: No. 12, 801-802(Dec 1977). (In German).

The likely main points of the expected debate are briefly described: 1. The decision relevance within the meaning of art. 100 Basic Law; 2. the substantive-constitutional argumentation of the OVG (Higher Administrative Court), section 7 of the Atomic Energy Act would be a breach of the principle of power sharing (art. 20, section 2, sentence 2 Basic Law).

50182 Cheap energy from where. Nuclear long-distance energy. Heating power plant with LWR reactors. Conventional heating power plant. Dehli, M. *Energie;* **29**: No. 11, 344-350(Nov 1977). (In German).

From today's point of view, the use of the 'Adam-Eva' system for the energy supply on the public power supply sector does not seem to bring advantages; one ought not to be too optimistic either about the process heat supply of industrial plants with this system. These are the conclusions the author draws having compared with the aid of model calculations heating power plants with LWR reactors and fossil-fired heating power stations with the 'Adam-Eva' system. Even in the case that the prices for fossil energy carriers continue to rise steeply, the nuclear heat from LWR reactors would remain cheaper for the time being than the energy from the 'Adam-Eva' system.

50183 Heat decoupling from nuclear power plants. Cost comparison LWR - HHT. Strickrodt, J. (Stadtwerke Wolfsburg A.G. (Germany, F.R.)). *Energie;* **29**: No. 11, 351-354(Nov 1977). (In German).

On the basis of well know data and under the assumption of an existing district heat system an attempt is made to compare the costs of the district heat to be extracted from a nuclear heat power plant on the basis of the standard LWR design (Biblis type) and an HHT (integrated reactor plant with spherical fuel elements operated by the OTTO cycle principle). For simplification it is assumed that the specific capital costs for the 1,300 MW LWR and those for the 1,000 MW HHT plants are roughly equal, i.e., approx. DM 1,800/kW. Accordingly, the cost study had to include merely the additional capital investment, the loss of electricity, and the additional operating costs involved in a coupled heat-power mode of operation. Most of the calculations are based on a 1975 price level..

50184 Coal gasification. Jaeger, W. (to Gesellschaft fuer Hochtemperaturreaktor-Technik m.b.H., Bergisch Gladbach (Germany, F.R.)). German(FRG) Patent 2,553,506/A/. 2 Jun 1977. 11p. (In German).

The thermal power of a 3,000 MWth HTR reactor is proposed for coal gasification. The plant is to generate methane and synthesis gas from carbonaceous materials; the gas yield is to be as high as possible with complete gasification of the carbon charge. The efficiency of the plant is the better the less nuclear heat is used for steam or power generation. At least two helium cooling circuits are used, the first of which incorporates a steam gasifier and a low-temperature carbonisation unit. Apart from the expulsion of volatile gases, the coal is also partly gasified in the low-temperature gasification unit. The second cooling circuit incorporates a cracking furnace where part of the methane generated is cracked to form hydrogen. The hydrogen is used in a hydro-gasifier for the gasification of part of the carbonaceous material. It is also possible to use only one gasifier for the endothermal water reaction and for exothermal hydrogasification.

50185 Principles of nuclear district heating. Melent'ev, L.A. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). *Teploenergetika (Moscow);* No. 11, 6-9(Nov 1976). (In Russian).

The principles are described of the nuclear heating network in the national economy. It is shown that the optimum utilization of nuclear fuel in the future fuel-energy balance of the USSR will be possible exclusively if it is widely used not only for electrical power supply, but also for heating. The most effective solution is the mixed condensation-thermal type of NPP, especially when the existing types of reactor are utilized for heating purposes. It is advisable to relocate some prospective NPP so as to bring them closer to the heat users in industry and the associated dwelling and utility construction projects.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 51442, 51511

50186 (AAEC/E—426) **Reactor calculations and nuclear information.** Lang, D.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1977. 15p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The relationship of sets of nuclear parameters and the macroscopic reactor quantities that can be calculated from them is examined. The framework of the study is similar to that of Usachev and Bobkov. The analysis is generalised and some properties required by common sense are demonstrated. The form of calculation permits revision of the parameter set. It is argued that any discrepancy between a calculation and measurement of a macroscopic quantity is more useful when applied directly to prediction of other macroscopic quantities than to revision of the parameter set. The mathematical technique outlined is seen to describe common engineering practice.

50187 Mathematical simulation of systems of equations of kinetics of a reactor on a digital computer in a real time scale. Arshakyan, D.T.; Muradyan, S.G.; Saakyan, A.P.; Galstyan, A.G. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 8, 21-23(Aug 1977).

Translated from Teploenergetika; 23: No. 8, 38-41(1976).

In mathematical simulation of unsteady transient processes in technological systems of nuclear power stations on a digital computer, it is necessary to select appropriate mathematical apparatus ensuring solution of a system of equations with sufficient accuracy and speed. This problem is particularly pressing in developing simulators for teaching operational staff of nuclear power stations (NPS) because in this case simulation of transient processes has to be carried out in a real time scale. The difficulties arising in doing so are associated both with selection of the mathematical method of solving the equations and with the fact that the processes in individual NPS systems differ both in nature and in time of proceeding. In this connection, selection of the mathematical method of solving a system of equations of kinetics of the reactor is of practical importance since realization of this system on a digital computer requires a very small step of integration (of the order of 10^{-3} s for a water-moderated water-cooled reactor), which sharply reduces the speed of calculations and increases the required memory of the computer. Described is an economical method of solving equations of neutron kinetics of the reactor with different allowable (specified) errors. The limiting step of integration is estimated at which the process of calculation by the methods examined is found on the boundary of stability.

50188 Method for rapid detection of unexpected reactivity insertion into a nuclear reactor. Kokame, H.; Nishikawa, Y. (Kyoto Univ.). *Nucl. Sci. Eng.;* **67**: No. 1, 8-18(Jul 1978).

The problem of rapid detection of an unexpected reactivity insertion into a nuclear reactor is studied assuming a stochastic point reactor model and noise measurements of neutron density. The fundamental assumption is that the time dependence of the reactivity is given as in a ramp function with unknown coefficients. Thereupon, the present method applies a likelihood ratio test to the innovation sequence obtained by using a discrete Kalman filter, which is designed for the steady-state condition of reactor operation. By numerical experiment, the mean delay time for detection has been obtained under the condition that the mean time between false alarms takes on a prescribed constant. A comparative study with some typical existing methods shows that the proposed method is remarkably effective except for extremely large or small inputs of reactivity.

50189 (IAE—2600) Computer code to calculate a two-group three-dimensional diffusion problem by the Galerkin method. Tsapelkin, E.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1976. 23p. (In Russian). Dep. NTIS (US Sales Only), PC A03/MF A01.

The paper describes the ROTA program devised for solving the two-group multizone diffusion problem in a parallelepiped. The program enables one to obtain the effective neutron multiplication factor and the flow distribution in both groups, and also some integral characteristics of the reactor. To solve the problem Galerkin's method is used with a special construction and choice of coordinate functions. The program is compiled in the language BESM-ALGOL for a GDR translator on the BESM-6 computer. Block diagram is described of the program and the mathematical statement of the problem. Tables of the symbols used the list of input information, and the structure of the information carriers are given. The text of the algol program and the control test solution are presented.

50190 (JAERI-M—7119) LOOM-P: a finite element mesh generation program with on-line graphic display. Ise, T.; Yamazaki, T. (Japan Atomic Energy Research Inst., Tokyo). Jun 1977. 41p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A description of the two-dimensional mesh generation program, LOOM-P, is given in detail. The program is developed newly to produce a mesh network for a reactor core geometry with the help of an automatic mesh generation routine built in it, under the control of the refresh-type graphic display. It is therefore similar to the edit program of the self-organizing mesh generator, QMESH-RENUM. Additional techniques are incorporated to improve the pattern of mesh elements by means of on-line conversational mode. The obtained mesh network is edited out as input data to the three-dimensional neutron diffusion theory code, FEM-BABEL.

50191 (JEN—392) Comparison of the eigenvalue equations in kappa, α, lambda and γ in reactor theory. Application to fast and thermal systems in unreflected and reflected configurations. Velarde, G.; Ahnert, C.; Aragones, J.M. (Junta de Energia Nuclear, Madrid (Spain)). 1977. 49p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A comparative study of the eigenvalue transport in kappa, lambda, γ and α is made. The neutronic fluxes obtained by solving the transport equation in the four eigenvalue types are compared numerically for fast and thermal systems in unreflected and reflected configurations. Important conclusions will be obtained about the appropiate use of each eigenvalue depending on the calculation type to be performed.

50192 Theoretical analysis of coupled-core reactors with the method of the moderator region response function. Shinkawa, M.; Yamane, Y.; Nishina, K.; Tamagawa, H. (Nagoya Univ., Japan). *Nucl. Sci. Eng.;* **67**: No. 1, 19-33(Jul 1978).

One-dimensional, one-energy-group diffusion theory is applied to a coupled-core slab reactor to derive kinetic equations for the system, with different modes of formulation taken for moderator regions and for core regions. For the former, the diffusion equation is exactly solved to obtain the time-dependent neutron currents from moderator to core (the moderator response function) in response to the neutron incident current in the form of a unit impulse on the boundary. For the core regions, the neutron flux psi(x,t) is written as a product of a shape function, phi(x,t), and a time function, P(t), as suggested by Henry, with P(t) chosen to represent the time variation of total importance over the respective core. The boundary terms that arise in the equations for P(t) are combined with incoming neutron currents at the boundaries, which in turn are expressed in terms of the moderator region reponse functions above. The equations for P(t) derived by such procedures include the coupling effect between the two cores, without a need for the conventional, a priori assumption of coupling coefficient. For the Argonaut two-slab core, the transfer functions are obtained and compared with existing values. The value of the conventional coupling coefficient is also inferred by reducing the present form of coupling terms by approximation. From the approximation needed in the procedure, the limitation of the coupling coefficient approach is discussed.

50193 Unified derivation of the various definitions of lattice cell diffusion coefficients. Hughes, R.P. (Berkeley Nuclear Labs., Eng.). *Nucl. Sci. Eng.;* **67**: No. 1, 85-90(Jul 1978).

The various definitions of lattice cell diffusion coefficients are discussed within the context of a one-dimensional slab lattice in one energy group. It is shown how each definition, although originally derived in its own particular way, can be derived from a single approach. This makes clear the differences between, and the advantages of, the various definitions.

50194 Higher order time-dependent generalized perturbation theory. Gandini, A. (Comitato Nazionale per l'Energia Nucleare, Rome). *Nucl. Sci. Eng.;* **67**: No. 1, 91-106(Jul 1978).

The time-dependent generalized perturbation theory is applied to the neutron and the nuclide fields to obtain a general perturbative formulation of the type of the Maclaurin expansion for functionals linear with the neutron or nuclide densities. Such functionals may represent, typically, activation detections or quantitative measurements of build-up or decayed higher isotopes of fuel materials. An alternative procedure is shown by which perturbation first- and higher order expansions of the neutron or nuclide density changes can also be obtained. Two simple but representative examples confirm the validity of the formulations.

50195 Unified definition of a class of Monte Carlo estimators. Lux, I. (Central Research Inst. for Physics, Budapest). *Nucl. Sci. Eng.;* **67**: No. 1, 107-119(Jul 1978).

A unified definition of a wide class of Monte Carlo reaction rate estimators is presented, since most commonly used estimators belong to that class. The definition is given through an integral transformation of an arbitrary estimator of the class. Since the transformation contains an arbitrary function, in principle an infinite number of new estimators can be defined on the basis of one known estimator. It is shown that the most common estimators belonging to the class, such as the track-length and expectation estimators, are special cases of transformation, corresponding to the simplest transformation kernels when transforming the usual collision estimator. A pair of new estimators is defined and their variances are compared to the variance of the expectation estimator. One of the new estimators, called the trexpectation estimator, seems to be appropriate for flux-integral estimation in moderator regions. The other one, which uses an intermediate estimation of the final result and is therefore called the self-improving estimator, always yields a lower variance than the expectation estimator. As is shown, this estimator approximates well to possibly the best estimator of the class. Numerical results are presented for the simplest geometries, and these results indicate that for absorbers that are not too strong, in practical cases the standard deviation of the self-improving estimator is less than that of the expectation estimator by more than 10%. The experiments also suggest that the self-improving estimator is always superior to the track-length estimator as well, i.e., that it is the best of all known estimators belonging to the class. In the Appendices, for simplified cases, approximate conditions are given for which the trexpectation and track-length estimators show a higher efficiency than the expectation estimator.

50196 Prompt-neutron lifetime measurement on MARIUS III critical facility. Gambier, G. (Electricite de France, Clamart). *Trans. Am. Nucl. Soc.;* **28**: 729-731(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50197 Performance of ENDF/B data in thermal reactor benchmark testing: some results with Version IV and prospects for Version V. Hardy, J. Jr. (Westinghouse Electric Corp., West Mifflin, PA). *Trans. Am. Nucl. Soc.;* **28**: 736-737(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50198 Rapid spectral and decay-heat calculations using processed ENDF/B fission product data. LaBauve, R.J.; England, T.R. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 749-750(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50199 Point kinetics as an asymptotic representation of space-, energy-, and angle-dependent reactor kinetics. Dorning, J.; Spiga, G. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* **28**: 761-762(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50200 Generation of cross-section probability tables. Troubetzkoy, E.S. (MAGI, Elmsford, NY). *Trans. Am. Nucl. Soc.;* **28**: 762-763(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50201 Extension of the R0CS coarse-mesh physics simulator to two energy groups. Ober, T.G.; Stork, J.C.; Bandera, R.P.; Terney, W.B. (Combustion Engineering, Inc., Windsor, CT). *Trans. Am. Nucl. Soc.;* **28**: 763-764(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50202 Generalized approach to nodal methods. Becker, M.; Harris, D.R.; Menezes, A.D.; Napolitano, D. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **28**: 765-766(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50203 Dependence of LWR sensitivity coefficients on the macroscopic spatial flux variation. Amorim, E.S.; Ryskamp, J.M.; Malaviya, B.K. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **28**: 766-767(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50204 Albedo conditions for power reactors. Bokharee, S.; Becker, M. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **28**: 767-768(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50205 Continuous slowing-down theory analysis of space-dependent fast reactor depletion. Biffer, J.; Becker, M.; Badruzzaman, A. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **28**: 770-771(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50206 Verification of a fuel assembly spectrum code based on integral transport theory. Jonsson, A.; Rec, J.R.; Singh, U.N. (Combustion Engineering, Inc., Windsor, CT). *Trans. Am. Nucl. Soc.;* **28**: 778-780(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50207 Validation results for the SDX cell homogenization code for pin geometry. McKnight, R.D. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 780-781(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50208 Effects of depletion, buildup, and fast fission on fission product decay heat. Trapp, T.J. (Oregon State Univ., Corvallis). *Trans. Am. Nucl. Soc.;* **28**: 798-799(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50209 Pool boiling of water heated by distributed internal heat sources. Kurtsman, E.D.; Suvorov, L.Y.; Ershler, B.V. (I. V.,Kurchatov Institute of Atomic Energy). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 857-861(Mar 1978).

The results of an experimental investigation of the boiling of water, heated by distributed internal heat sources, in a volume of up to 65 liters at $P_0=1$ bar are given. The nature of the boiling depends on the heating power: With increase in power the pulsed boiling regime changes to a steady regime. The boiling layer formed acts as a regulator of vapor production.

50210 Analysis of small cylindrical fast systems by Monte-Carlo method. Subbukutty, K.; Navalkar, M.P. (Bhabha Atomic Research Centre, Bombay (India). Neutron Physics Section). *Atomkernenergie;* **31**: No. 1, 21-22(1978).

A total of 17 fast systems with cylindrical geometry have been studied using Monte-Carlo method. Besides ksub(eff), mean generation time, tausub(P) and mean destruction time tausub(D) have been calculated, thereby showing that Monte-Carlo method can be used to solve reactor geometries in multi-dimensions and multigroup formalism with sufficient accuracy and reasonable computing time.

50211 Numerical solutions to critical problem of reflected cylindrical reactor. Horie, J. (Kyoto Univ, Jpn). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 12, 847-858(Dec 1977).

The multi-region critical problem can be transformed into an eigenvalue problem in the classical sense by using the method of Kuscer and Corngold and of Wing. This transformation is applied to derive a variational formulation for a reflected reactor. An approximate critical value of the multiplying factor is determined by maximizing the Rayleigh quotient for radially and totally reflected cylindrical reactors. It is shown that this approximate critical value is an upper bound of the true critical value. From the facts that the operator is self-adjoint and the eigenfunction is positive, an expression is derived for the upper and lower bounds of the true eigenvalue, by making use of the approximate distribution. The narrow bounds are calculated for two radially and one totally reflected cylindrical reactors. 20 refs.

50212 Decoupling control of nonlinear coupled core reactor. Tsuji, M.; Ogawa, Y. (Hokkaido Univ, Jpn). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 12, 859-868(Dec 1977).

This paper concerns the application of the decoupling theory for a nonlinear system to the power control of the coupled core reactor. By using this theory the authors can deal with the power change problem, the regulating problem for a system subject to a large perturbation, etc., which cannot be dealt with by the decoupling theory for a linear system. But, since this theory asuumes tacitly that all the states are measurable, the theory can not be applied directly to the nuclear reactor that has nonmeasurable state variables such as the delayed neutron precursor. In this paper, the above difficulty is overcome by introducing the observer theory for a nonlinear system. The decoupling controller and observer resulting from these theories are applied to the coupled core reactor and the dynamic characteristic of the reactor is simulated by the digital computer. The simulation shows that the reactor power of each core is controlled satisfactorily in decoupling manner. 6 refs.

50213 Measurement of neutron importance by a dynamic method. Dmitriev, V.M.; Matusevich, E.S.; Regushevskii, V.I.; Sazonov, S.P.; Usikov, D.A. *At. Energ. (USSR);* **43**: No. 1, 8-11(Jul 1977). (In Russian).

A procedure is proposed for measuring neutron importance spatial distribution in a critical reactor by determining the parameters of its run-up with a constant neutron source. ^{252}Cf quasiisotropic point source was used. The measurements were performed at a critical assembly with a highly enriched uranium core and beryllium reflector. Importance distributions in critical and subsritical assemblies were compared for various degrees of subcriticality. Absolute normalization for the importance was obtained, and some new integral reactor characteristics were determined experimentally on

its basis. An experimental data acquisition and processing system was developed on the basis of the ELECTRONIKA-100 computer. An algorithm was also developed for statistical treatment of the data. The importance distributions in critical and subcritical assemblies proved to coincide up to a rather deep subcriticality.

50214 Radiation streaming: the continuing problem of shield design. Avery, A.F. (Atomic Energy Establishment, Winfrith, Eng.). pp 169-178 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

The practical problems of shield design are reviewed and the major difficulties are shown to be those associated with streaming problems. The situations in which streaming occurs in various types of reactor are described including LMFBR's and fusion devices, and examples are given of ways in which the problems have been solved.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 49935, 50287, 50682, 50702, 50909, 50911, 51047, 51518

50215 (TID—28487) **Quality assurance engineering for nuclear and other complex facilities.** Bohannon, J.R. Jr. (North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering). 1 Mar 1978. Contract EY-76-S-05-4760. 475p. Dep. NTIS, PC A20/MF A01.

A text is presented which is intended to provide the senior level engineering student with a working understanding of the basic principles, practices, and philosophies of quality assurance.

50216 (ZfK—343) **Automatic process control of coolant temperature.** Pietzsch, G. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Sep 1977. 10p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

A description is given of the development of a simple computer code for the control of the cooling water temperature. The accuracy for expected break-downs and alternating working conditions is +- 0.5 degrees. The fundamental idea is to determine early the input and output quantity of heat, which must be in the balance. The program is working for service and meets the tasks. It needs 160 store locations per 33 bits, if subroutines are used.

50217 Use of variational techniques for the estimation of neutron detection efficiency. Lin, S.C. (Univ. of Tennessee, Knoxville); Robinson, J.C.; Selby, D.L. *Nucl. Sci. Eng.;* **67**: No. 1, 61-73(Jul 1978).

The Lewins variational functional was employed to formulate approximations to the neutron detection efficiency, which is a parameter required in the measurement of reactivity by the modified source multiplication technique. In particular, a conventional variational method, a variational extrapolation method, a variational interpolation method, and a multi-reference-state variational method were developed for estimating neutron detection efficiency. Results obtained using the various approximate techniques in one and two dimensions were compared with results from exact formulations. The results obtained using the multi-reference-state variational method in all cases and the variational interpolation method in most cases compared very favorably (discrepancies <5%) with results from the exact calculations. The approximate techniques can be cast in a form where very simple calculational capabilities are all that are required to obtain detection efficiency for any given (but arbitrary) subcritical state. Therefore, we conclude that the methodology developed herein would be applicable to on-line applications using minimal computer capabilities.

50218 EPRI instruments reach commercial market. *EPRI J.;* **3**: No. 4, 12-13(May 1978).

The Electric Power Research Institute has developed instruments capable of verifying time responses of power plant pressure sensors and temperature sensors. A patent is pending on the pressure-sensor device, and the temperature-sensor device is already commercially available. The devices, EPRI's first hardware products to be marketed, are the result of research to find technological solutions to the problems of knowing the time period when temperature and pressure changes occur in light water reactors. The hydraulic pressure-sensor device is a portable unit that can conveniently test equipment in place. Utilities can obtain detailed information from EPRI's project report to construct their own. The loop current step response (LCSR), measuring resistance temperature, is also a compact system suitable for in-plant testing.

50219 Procuring nuclear components. Miller, S.S. *Power Eng.;* **82**: No. 2, 70-72(Feb 1978).

Utilities that have introduced a nuclear capability to their systems are discovering that components for these plants generally are delivered late and at a cost, even allowing for inflation, that is two to three times greater than the cost of the same type of part for non-nuclear application. Architect/engineers and utilities can help to reduce lead times in component deliveries and, in turn, reduce field construction costs. Utilities, for example, can help their own cause by not allowing a supplier with a poor record to bid, or to assess a penalty to him as part of the evaluation. This is especially critical in selecting bids for power piping, hangers and supports, and station valves, each category of which will consist of about 5000 items that are mostly custom designed.

50220 Theoretical study of aircraft impact on reactor containment structures. Carlton, D.; Bedi, A. (Taylor Woodrow Construction Ltd., Southall (UK)). *Nucl. Eng. Des.;* **45**: No. 1, 197-206(Jan 1978).

In containment design there is a requirement to protect the reactor system from the effects of external hazards and hence it is necessary to provide suitable wall thicknesses. Experimental work undertaken by the UKAEA is being carried out as a general study and this paper describes some theoretical studies for the particular case of an aircraft impact. The theoretical study utilizes a finite difference dynamic code based upon dynamic relaxation initially developed for static problems. The code models concrete, reinforcement and prestressing throughout the short term non-linear range. Concrete is assumed to have a limited tensile stress capacity, coupled with a shear carrying capacity which is dependent upon the aggregate and crack size. In addition a yield condition can be specified to allow for triaxial stress states both initial and subsequent to failure. The paper briefly describes the theory and makes comparisons for different concrete thicknesses.

50221 Transient cavitation effects in fluid piping systems. Kot, C.A.; Youngdahl, C.K. (Argonne National Lab., Ill. (USA)). *Nucl. Eng. Des.;* **45**: No. 1, 93-100(Jan 1978).

An accurate prediction of pressure transients and associated loadings in nuclear power plant piping systems requires a treatment of cavitation. A technique for calculating this effect in a general fluid-hammer analysis by the method of characteristics is developed. Cavitation is treated by a modified column separation model and is assumed to be a local phenomenon occurring whenever the pressure drops below the vapor pressure of the fluid. While the model is a simplification of the actual phenomena it reproduces the essential features of transient cavitation. Computational results obtained for a variety of piping arrangements demonstrate the versatility of the approach, and clearly illustrate the fact that neglecting cavitation leads to erroneous pressure-time loadings in the piping systems. Comparisons of calculated results with available experimental data, for a simple piping arrangement, show good agreement and provide validation for the computational cavitation model.

50222 Causes of stress relief cracking in heat-affected zones of low-alloy, fine-grained structural steels. Tenckhoff, E.; Mueller, G. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). pp 797-800 of Reaktortagung, Hannover, 4.4.-7.4.1978. Sektion 5: Komponenten und Komponenten-Werkstoffe, Qualitaetssicherung. Eggenstein-Leopoldshafen, Germany, F.R.; ZAED (1978). (In German)

From Reactor congress; Hannover, F.R. Germany (4 Apr 1978).

50223 Remotely controlled manipulator vehicle MF3. Koehler, G.W. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Abt. Reaktorbetrieb und Technik). *Kerntechnik;* **19**: No. 12, 541-548(Dec 1977). (In German, English).

This paper describes a light remotely controlled manipulator vehicle suitable for use inside buildings which is made possible by a variable chassis geometry which also presents several other advantages. The new principle possesses a great development potential, both in the sense of simplification and in the sense of greater versatility. The vehicle is also suitable for non-nuclear tasks, is not necessarily limited to small vehicles. The equipment of the vehicle is rapidly exchangeable.

50224 Characterization and evaluation of common methods of measuring J/sub Ic/-values for nuclear pressure vessel steels. Stahlberg, R. *Z. Werkstofftech.;* **8**: No. 12, 399-407(Dec 1977). (In German).

A J/sub Ic/ test procedure using a single deeply cracked specimen was proposed. The crack extension is measured by partially unloading the specimen to determine the elastic compliance. J/sub Ic/ tests were made using ferritic steels. No size effect was found. The errors due to simple formulation of J/sub I/ calculation, periodic partial unloading, and simplified analysis for the extension of deep cracks in compact specimens are explored. The measurement point of crack extension for establishing J/sub Ic/ is discussed. Moreover, a proposal of characterising J/sub Ic/ by means of a resistance curve

technique was developed. J-values from CT-specimens containing a deep precrack are plotted as a function of crack extension measured from the specimen fracture surface. Using these plots a technique is suggested for establishing a J/sub Ic/ measurement point. Finally, a step-by-step procedure for measuring J/sub Ic/ was outlined.

50225 RS reactor safety, safety of other nuclear facilities, radiation protection. *Gemeinsames Ministerialbl., A;* **28**: No. 30, 661(Dec 1977). (In German).

The following topic are included: (1) informations on the concept; (2) start of the production of semi-finished products; (3) processing, handling, and treatment of semifinished products; (4) plant assembly; (5) installation of internals; and (6) start-up of operation.

50226 Publication concerning the draft of a safety guideline for nuclear power plants (safety guide) of the International Atomic Energy Agency. *Bundesanzeiger;* **29**: No. 226, 1(Dec 1977). (In German).

The Ministry of the Interior invites amendment suggestions for the final comment from the FRG on the 'Safety Guide on Quality Assurance Records System (SG-QA 2)' of the IAEA.

50227 Possibilities and limits of water pressure testing of vessels and piping systems especially at nuclear power plants. Bergemann, W. (Staatl Amt fuer Atomsicherheit und Strahlenschutz der DDR, Berlin, E Ger). *Energietechnik;* **27**: No. 11, 458-466(Nov 1977). (In German).

In accordance with the currently applied testing procedure taking place every 8 years, the water pressure test has only a slight safety engineering value. Taking into account the knowledge of fracture mechanics, a geometrical test sequence is proposed. In plants where conditions deteriorate in the course of operation (material embrittlement due to irradiation by neutrons), a test sequence according to approximately arithmetical progression is recommended. The considerable number of tests in both cases can be reduced by combining them with acoustic emission analysis.

50228 Breakup of droplets in a wet steam turbine stage under the effect of vibrations. Perel'man, R.G.; Kolubev, V.K. (Moscow Aviat Inst, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 145-147(Oct 1977). (In Russian).

In evaluating the sizes of droplets dispersed in the axial clearance of a wet steam turbine stage, it is proposed to take into acount the possibility of their breakup when the frequency of the forced vibrations of the flow, caused by rotor revolutions, approaches the natural frequencies of vibration of the droplets. The likelihood of this phenomenon for nuclear power plant turbines is demonstrated. The data obtained may be utilized, in particular, in predicting the erosion resistance of rotor blades. 12 refs.

50229 Investigation of the processes of ion exchange sorption of boric acid and its reagentless desorption. Donrevski, I.D.; Konova, G.B. (VKhTI, Burgas, Bulg). *Teploenergetika (Moscow);* No. 10, 84-86(Oct 1977). (In Russian).

Experimental data are presented on the equilibrium exchange capacity (EEC) of Wofatite RO in static conditions in the system, ionite--aqueous solutions of H$sub 3$BO$sub 3$, with concentrations of 1-12 g/l, with addition or without addition of chlor-ions, ammonium, and potassium ions in concentrations characteristic for the water in the first loop of a nuclear power plant. Data are also presented on the processes of sorption of H$sub 3$BO$sub 3$ from aqueous solutions under dynamic conditions (filtration ion exchange) and desorption of sorbed H$sub 3$BO$sub 3$ by solutions containing H$sub 3$BO$sub 3$.

50230 Effect of mass velocity of the coolant and mass vapour content on the intensity of the deposit formation process. Kot, A.A.; Pshemenskii, A.A. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 8, 53-55(Aug 1977).

Translated from Teploenergetika; 23: No. 8, 66-68(1976).

A considerable number of steam generators at thermal and nuclear power stations work at high thermal loadings in the regime of annular and dispersed flow of a steam-water mixture in the fuel element channels. With steam formation on the fuel element surfaces the features of mass transfer in the wall-adjacent layer and its intensity affect to a considerable extent the rate of deposit formation. Steam-water mixtures, having a dispersed-annular flow structure, i.e., a water film at the tube wall and a two-phase medium in the core of the flow (water droplets in steam) exist within a wide range of change in mass steam contents. Results of experiments to compare the thermal and hydraulic regimes in which formation of the maximum amount of deposits occurs with the regime of impaired heat transfer are presented.

50231 Seismic design of electrical equipment and instrumentation for nuclear power stations. Suzuki, Y.; Nishizawa, K.; Miyazaki, Y.; Miura, T. (Hitachi Ltd., Tokyo (Japan)). *Hitachi Hyoron;* **26**: No. 6, 195-201(Jun 1977).

To ensure the safety of nuclear power stations at an earthquake, it is necessary to establish seismic capabilities of electrical equipment and instrumentation as well as equipment and piping. While in equipment and piping, mechanical strength is the main factor involved, in electrical equipment and instrumentation, functional sustenance is another important factor. Accordingly, the latter requires special design, and various methods of seismic qualification have been studied. Among them, the static method -- in which the rigidity of electrical equipment and instrumentation is improved, and their seismic capabilities are qualified -- is simple, convenient and universally applicable. By this static method as the base, tests and investigations were conducted on seismic capabilities of major electrical equipment and instrumentation such as control panels, metal-clad switchgears, motor control centers, local instrument panels, and batteries. Their seismic capabilities were appraised and qualified.

50232 Device for closing defective heat exchanger tubes. Bergbauer, A.; Ploeger, M.; Seyd, G. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,124,530/B/. 1 Mar 1977. 4p. (In German).

This is a device for closing defective heat exchanger tubes in the tube plate region. A metallic plug with a central bore containing a blasting charge and a primer is introduced into the defective tube by explosion welding.

50233 Radiographic inspection of atomic power station units with the help of a microtron. Gromov, Yu.V.; Zykin, L.M.; Kalinin, V.P.; Leonov, B.I.; Petrov, B.E.; Rudovskii, B.P.; Smirnov, O.P. *Defektoskopiya;* No. 2, 89-94(1977). (In Russian).

Some aspects of radiographic control of thick-walled vessel equipment of NPP are considered. Experimental evaluation of flaw detection sensitivity in control of steel samples and products with a thickness within 440 mm using 10 MeV microtrone, X-ray RI-30T television introscope and the X-ray film has been conducted.

50234 Finite Elementberechnung von Spannbeton-Reaktordruckbehaeltern. (Finite element calculation of prestressed-concrete reactor vessels). Argyris, J.H.; Faust, G.; Szimmat, J.; Warnke, E.P.; William, K.J. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen). Berlin, Germany, F.R.; Ernst (1977). 34p. (In German).

On the research side discretisation problems were investigated for the finite element idealisation of PCRV in addition to questions with regard to long term creep and concrete failure in the ultimate load regime. Special attention was given to the triaxial load conditions in massive structures and the specific concrete properties under hygrothermal environments. On the development side the finite element system SMART was programmed for the analysis of prestressed concrete reactor vessels. It consists of two parts: a) SMART I - statics; b) SMART II - diffusion. SMART serves both the static analysis of stresses and deformations and the computation of hygrothermal boundary conditions in massive structures within a compatible software package. The report summarizes the theoretical fundamentals of SMART and illustrates specific features with the several examples.

50235 Zur Konvertierung von SMART I. (Conversion of SMART I). Argyris, J.H.; Szimmat, J.; William, K.J. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen). Berlin, Germany, F.R.; Ernst (1977). 35-63p. (In German).

The report describes the conversion of the programming system SMART I on CDC, UNIVAC and IBM computers under the BMFT grant RK 21 I/SBB 31. There were four tasks for the development of a machine-independent SMART-version: a) Updating of the CDC source library (ca. 180.000 Fortran statements); b) Conversion into double precision; c) Primary installation on UNIVAC; d) Primary installation on IBM. The conversion of the SMART I program was carried out in cooperation with the consulting firms RIB, Stuttgart, and IKOSS Stuttgart, under the leadership of ISD.

50236 Testing of piping in nuclear power plant. Solbeck, K. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.)). *Three R Int.;* **16**: No. 8, 469-475(1977). (In German).

In view of the considerable safety risks involved in the operation of nuclear power plant, exacting demands must be imposed on the selection of the materials used, pipe design and dimensioning and on quality control in fabrication. No mandatory set of standard specifications is as yet in existence for piping in nuclear power plant. For each particular plant it is therefore necessary for the specific requirements to be determined by expert opinion. This must extend from the design and load assumptions to the fabrication, inspection and ultimate use of the piping. A pipe line must be regarded as an integrated system and the inspections carried out

during fabrication are to ensure that upon completion the system fully meets the design assumptions.

50237 Cladding of pressure vessel steel with corrosion resistant filler material. Vartiainen, K. (Finlands Akademi, Helsingfors). *Suvrem. Med.;* **35**: No. 1, 7-18(Jan 1976). (In Swedish).

Pressure vessels are often on the inside clad with corrosion resistant material. Of the various cladding processes surfacing by welding has proved to be most useful, especially for large thick-walled pressure vessels. Submerged arc welding with strip electrode is the most common method. Rather promising results have also been obtained by plasma hot wire welding. In general, Nb-alloyed austenitic stainless steel, over-alloyed with Cr and Ni, is used as filler material. Henceforth, also nickel alloys, e.g. Inconel 600, are used. The surfacing is made in one or several layers, following the requirements on the clad surface and the welding process used. The most dangerous welding defects in the surface are various types of cracks. The corrosion resistance of the cladding can show rather high local variations, depending on the composition of the filler material and various welding process factors. It is proved that the surface layer comparises areas with low chromium martensite. To ensure the corrosion resistance of the cladding, the generation of low-chromium martensite must be prevented by using suitable welding parameters, welding equipment and filler metal.

FUEL ELEMENTS

50238 (FEI—703) **Calculation of stresses and deformations in a cylindrical shell with imperfect initial shape and at the circumference nonuniform temperature.** Leonchuk, M.P.; Pyl'chenkov, E.Kh.; Dvortsova, L.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1976. 16p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

A method is proposed for calculating the stress-strain state of a thin cylindrical shell with initial shape imperfections under conditions of peripheral nonuniformity of temperatures and a prolonged effect of external loads. The method is based on the plane deformation hypothesis, it takes into account geometrical nonlinearity and also the steady and nonsteady stages of creep. Different schemes are considered of the problem realization on the computer. The possibility of using the method for analyzing stresses, strains and lifetime of the fuel elements and other reactor elements is demonstrated.

50239 (JEN—388) **Theory of a new elastic-plastic-viscous model and its application to the nuclear fuel mechanical analysis.** Moreno, A. (Junta de Energia Nuclear, Madrid (Spain)). 1977. 132p. (In Spanish). Dep. NTIS (US Sales Only), PC A07/MF A01.

A new elastic-plastic-viscous model is described. The model is one of the multiple integral type, and has been included in a numerical code to predict the behaviour of a nuclear fuel of cylindrical form. Some features of this code are also described.

50240 (SGAE—2614) **Amoeba behaviour of UO_2 coated particle fuel.** Wagner-Loeffler, M. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Jun 1976. 24p. (CH—189/76). Dep. NTIS (US Sales Only), PC A03/MF A01.

A survey of data relevant to the assessment of amoeba failure parameters is presented. The data which can be extracted from the various sources were used to derive amoeba endurance parameters which were also compared to ones from other sources. The governing mechanism is discussed.

50241 CRAKR: steady-state asymmetric temperature distributions in nuclear fuel rods. Williford, R.E.; Hann, C.R. (Battelle Northwest Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 422-423(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50242 Fission gas effects in irradiated fuel rods operated in film boiling at high power. Mehner, A.S.; Ploger, S.A.; Quapp, W.J.; Hobbins, R.R. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 423-424(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

CONTROL SYSTEMS

50243 Zion simulator run verifies new load-follow methods. Dzikowski, K.J.; Gray, D.C. (Westinghouse Electric Corp., Pittsburgh). *Trans. Am. Nucl. Soc.;* **28**: 703-704(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50244 Control rod interactions in ZPPR-7G, a heterogeneous LMFBR benchmark assembly. Collins, P.J.; McFarlane, H.F.; Carpenter, S.G. (Argonne National Lab., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 782-783(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50245 Modeling of BWR control blades for nodal calculations. Menezes, A.D.; Becker, M.; Harris, D.R. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **28**: 797(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50246 Uses of digital computers in nuclear power plants. Swanenburg de Veye, R.J. (Stichting Energieonderzoek Centrum Nederland, Petten). *Energiespectrum;* **2**: No. 3, 74-83(Mar 1978). (In Dutch).

A survey is given of the Halden (Norway) project of research into the role a digital computer can play in the various control and management functions of a nuclear power plant, and the part that the Netherlands' Energy Research Centre had in the project, as well as the available results.

50247 Absorber balls tested for LMFBR secondary shutdown. Marshall, P. *Nucl. Eng. Int.;* **23**: No. 266, 26-27(Jan 1978).

The hydraulic performance of a column of tantalum alloy absorber balls and a flow shutoff valve which could be used as a fast breeder shutdown assembly is being evaluated in the Hydraulic Testing facility at the Liquid Metal Engineering Centre in California. The balls are designed to fall into the reactor core by gravity when the coolant flow is interrupted. A second concept involves and articulated absorber with a high degree of chain-like flexibility. Both systems are intended for an Inherent Secondary Shutdown System for advance LMFBRs. Assemblies and tests are briefly described.

50248 Experimental investigation of digital algorithms for direct control of neutron flux on the IRT-2000 reactor. Filipchuk, E.V.; Potapenko, P.T.; Kryukov, A.P.; Trofimov, A.P.; Dunaev, V.G.; Kuznetsov, N.A.; Fedulov, V.V. *At. Energ. (USSR);* **42**: No. 5, 365-369(May 1977). (In Russian).

Experimental investigations of the dynamics of a system using a computer for a research reactor power distribution control have been conducted. Performance of the system has been checked under different routine disturbances. The hardware and software schemes allowing to simulate basic operating regimes of the controlling computer are described. A controlling algorithm is proposed, which ensures simultaneous stabilization of the total reactor power and the given neutron flux distribution. The results obtained may be used to design computer - oriented control systems for power reactors.

50249 Material reactivity worth measurements in a fast reactor. Nargundkar, V.R.; Bazu, T.K.; Chandramoleshvar, K.; Dzhob, P.K.; Subba Rao, K. (Bhabha Atomic Research Centre, Bombay (India). Neutron Physics Section). *At. Energ. (USSR);* **42**: No. 5, 383-386(May 1977). (In Russian).

Experimental investigations of reactivity worths of fuel elements and some reactor materials have been performed to evaluate their potential use in the control and safety systems of the KPFR pulsed fast reactor. The measurements have been conducted at the test subcritical PURNIMA facility, the core of which is of asymmetrical hexagonal shape and surrounded by a copper reflector. The fuel elements represent stacks of dense PuO_2 pellets clad by stainless steel. To measure neutron multiplication a reference gauge element has been used. The fuel element worth has been found to vary from 1.53 β at the core periphery to 3.33 β at the centre. For such metals as Cu, Mo, Th and stainless steel the worths amount to 0.4 - 0.5 β. According to the results obtained with control rod simulators beryllium and natural uranium specimens produce maximum effects. The fuel element worths are concluded to be adequate to use the elements as scram rods.

50250 Future-oriented control system for power plant automation. *BBC-Nachr.;* **59**: No. 11, 494-495(1977). (In German).

A description is given of the power plant control system procontrol which automates all measuring,.open-loop and closed-loop control tasks in power plants as far as possible and thus protects the plant against human errors.

50251 Control and shutdown system of the KNK-II. Mehren, F.; Hindrichs, D.; Kimpel, R.; Nowitzki, F.; Vogt, F.; Voj, P. (Interna-

tionale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). *KFK Nachr.;* **9**: No. 3, . 24-25(1977). (In German).

As safety engineering in its present state always starts from the assumption that systems may fail wholly or partly due to specific failure mechanisms, two shutdown systems have been provided for the KNK-II reactor, each of which is designed for the maximum design basis accident. To exclude the possibility of common-mode failure, maximum diversity has been the target in planning the systems. The first shutdown system also has the function of control.

50252 Process computers and their application in the KNK-II reactor. Schoeller, H.; Richard, H. (Kernkraftwerk-Betriebsgesellschaft m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)); Lindhorst, H.; Schlottmann, D.; Schneeloch, D. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). *KFK Nachr.;* **9**: No. 3, . 50-51(1977). (In German).

With the aid of an assumed accident, the report presents some of the main tasks of process computers. The programme system is designed for the special situation of the KNK. The process computer is to increase plant availability, and to be an aid in trial operation. It facilitates: a) early detection of oncoming disturbances, b) analysis of actual disturbances, c) process studies, d) plant control, e) routine work.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 50146, 51039, 51040, 51082

50253 Environmental monitoring of construction impacts at a nuclear power plant. Smith, B.W. (Public Service Co. of New Hampshire, Manchester). *Trans. Am. Nucl. Soc.;* **28**: 684(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

SITING

50254 Effective seismic input through rigid foundation filtering. Ray, D.; Jhaveri, D.P. (URS/John A. Blume and Associates, Engineers, San Francisco, Calif. (USA)). *Nucl. Eng. Des.;* **45**: No. 1, 185-195(Jan 1978).

A simple yet realistic approach is developed to account for a class of important soil-structure interaction phenomenon, namely wave scattering. The foundation is considered to act as a filter, partitioning the impinging excitation into low-pass filtered translational motion together with torsional motion (for horizontally polarized shear and Love waves) and rocking motion (for compressional, vertically polarized shear, and Rayleigh waves). These effects are evaluated for arbitrarily incident, horizontally polarized shear waves. The results are expressed in terms of filtering functions for various foundation geometries and embedment conditions and compared with 'exact' and other approximate solutions. Numerical results for a time history are presented in the form of translational and torsional acceleration response spectra.

RADIOACTIVE EFFLUENTS

50255 Optimization of radiological environmental surveillance programs. Desrosiers, A.E. (Yankee Atomic Electric Co., Westboro, MA). *Trans. Am. Nucl. Soc.;* **28**: 682-683(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50256 Guidance for the design of nuclear power reactor radiological environmental monitoring programs. Porter, S.W. Jr. (Porter-Gertz Cnsultants, Inc., Ardmore, Pa. (USA)). *J. Inst. Nucl. Eng.;* **19**: No. 1, 6-10(1978).

The criteria and methods for the design of a modern nuclear power radiological environmental monitoring programme are discussed in the light of recent US Guides, and the US Nuclear Regulatory Guides for Nuclear Power Plant Radiological Environmental Monitoring are reviewed in detail. A four stage design is recommended, comprising Stage I Investigational, Stage II Preoperational, Stage III Operational, and Stage IV Continuing Operational. Problem areas discussed include timing of the four stages, representative sampling, required analytical sensitivities, and timely report preparation. The four phases are interrelated and the design of each succeeding phase is dependent on the findings of the preceding phase. The programme is outlined chartwise. It is hoped that the paper will stimulate some discussion by comparing and contrasting its concepts with those of the UK radiological environmental monitoring programmes. 15 references.

50257 Environmental exposure measurements in and around the site of nuclear facilities. Moriuchi, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). *Radioisotopes (Tokyo);* **26**: No. 4, 266-275(Apr 1977). (In Japanese).

Problems in measurement of γ-ray in environment generated by an operation of nuclear facilities, and practical measurement methods were given an outline. ^{85}Kr and ^{133}Xe were mentioned as main nuclides which were released from various kinds of atomic piles for commercial business or research. Problems in measurement of low level γ-ray by measurement instruments such as a ionizing chamber, NaI (TL) detector, GM counter, and TLD were mentioned. Measurement of accumulated dose with TLD was described, and the change with a progress of time in the measurement objects (γ-ray, fallout γ-ray, and plume γ-ray in nature) and its characteristic patterns were showed. Information which were used for identification of minute components in facilities and natural radiation, and method for identification were described. Last, comparison of results of dose measurements and values estimated by calculation was described, and importance of storage of monitoring data was described.

CHEMICAL AND THERMAL EFFLUENTS

50258 Alternative methods of minimizing fish mortalities due to air supersaturation in thermal discharge. Davis, G.J. (Boston Edison Co.); Krabach, M.H.; Marcello, R.A. *Trans. Am. Nucl. Soc.;* **28**: 683-684(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 50086, 50248, 50251, 50252, 50282, 50286, 50289, 50292, 50306, 50815, 51442, 51521

50259 (IWGFR—21, pp 133-164) **FFTF scale-model characterization of flow induced vibrational response of reactor internals.** Ryan, J.A.; Julyk, L.J. Dec 1977.

From International Atomic Energy Agency, international working group on fast reactors; Argonne, IL, USA (20 Sep 1977).

In Specialists meeting on LMFBR flow induced vibrations.

As an integral part of the Fast Test Reactor Vibration Program for Reactor Internals, the flow-induced vibrational characteristics of scaled Fast Test Reactor core internal and peripheral components were assessed under scaled and simulated prototype flow conditions in the Hydraulic Core Mockup. The Hydraulic Core Mockup, a 0.285 geometric scale model, was designed to model the vibrational and hydraulic characteristics of the Fast Test Reactor. Model component vibrational characteristics were measured and determined over a range of 36% to 111% of the scaled prototype design flow. Selected model and prototype components were shaker tested to establish modal characteristics. The dynamic response of the Hydraulic Core Mockup components exhibited no anomalous flow-rate dependent or modal characteristics, and prototype response predictions were adjudged acceptable.

50260 FFTF status. Mangelsdorf, T.A. (Westinghouse Hanford Co., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 704-705(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50261 Irradiation test program for FFTF. Corrigan, D.C.; Last, G.A. (Westinghouse Hanford Co., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 705-707(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50262 Long-distance transfer of TRIGA reactor fuel. Richards, W.J.; Stephens, W.E. (Argonne National Lab., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 708-709(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50263 Optimization of the University of Missouri Research Reactor fuel cycle. Camp, A.L. (Sandia Labs., Albuquerque, NM); Sanders, R.C. *Trans. Am. Nucl. Soc.;* **28**: 709-710(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50264 Response of EBR-II delayed-neutron monitor to tramp uranium and a fission product test source. Fryer, R.M. (Argonne National Lab., Idaho Falls); Reyes, L.A.; Strain, R.V. *Trans. Am. Nucl. Soc.;* **28**: 710-711(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50265 Calculation of resonant reaction rates near region interfaces in the FTR. Rothrock, R.B. (Westinghouse Hanford Co., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 774-776(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50266 Computational method for predicting neutron hodoscope performance. Hosteny, R.P. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 777-778(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50267 Radial-reactivity-coefficient weighting schemes for a fast reactor. Grimm, K.N. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 785-786(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50268 Delayed-neutron parameters for the FFTF. Daughtry, J.W.; Dobbin, K.D. (Westinghouse Hanford Co., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 790-792(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50269 Last experiments with the KEMA Suspension Test Reactor. Kersten, J.A.H.; van der Veer, J.H.C. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). *Energiespectrum;* **2**: No. 2, 38-42(Feb 1978). (In Dutch).

A discussion of the research program with the KSTR reactor in the period 1975-1977 is given. On 22 May 1977, the license for operating the reactor expired. Attention is paid to the procedure of taking samples of the suspension and to the amount of fissionable materials which have been retained in the reactor system. Fluctuations in the reactor power, in the reactor temperature and in the concentration in the reactor vessel are discussed. Some final conclusions are presented.

50270 Some relations of neutronic noise with fluctuation of inlet coolant temperature and vibration of a control rod obtained by simultaneous measurements at kur. Oka, Y.; An, S.; Kimura, Y.; Kimura, I. (Univ of Tokyo, Jpn). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 12, 869-877(Dec 1977).

Experiments on reactor noise were conducted at KUR. Depending on the operating condition of the reactor, the cause othe noise is classified into four types. Vibration of a spare shim control rod and fluctuation of inlet coolant temperature were measured simultaneously with the neutronic noise. The fluctuation of inlet coolant temperature is nonwhite noise and consists of large low frequency component. The theoretically predicted sink structures in the neutronic PSD relating to the transit time of inlet coolant temperature fluctuation through the core were not observed in the experimental results. 16 refs.

50271 Experimental RBT-6 reactor. Tsykanov, V.A.; Aver'yanov, P.G.; Burukin, V.P.; Zaletnykh, B.A.; Kormushkin, Yu.P.; Korotkov, R.I.; Kusovnikov, A.S.; Spiridonov, Yu.G. *At. Energ. (USSR);* **43**: No. 1, 3-7(Jul 1977). (In Russian).

Design and basic parameters are described of the experimental pool BBT-6, reactor constructed within the building of SM-2 reactor and using its spent fuel sub-assemblies as fuel. The reactor is simple in design and easily accessible during experiments. At 6 MW nominal power, high neutron fluxes and long-term continuous operation can be achieved. The reactor may be recommended as an experimental facility for irradiation of various materials up to average fluences in the range of 10^{19} - 10^{21} n/cm^2 and for investigating properties of materials during irradiation.

50272 Alteration of a reactor installation (the experimental fast reactor facility) at Oarai Engineering Center of Power Reactor and Nuclear Fuel Development Corporation. *Genshiryoku Iinkai Geppo;* **21**: No. 12, 7-9(Mar 1977). (In Japanese).

This is report by the Atomic Energy Commission to the Prime Minister, and the report by the Committee on Examination of Reactor Safety to the Atomic Energy Commission of Japan concerning the subject matter is attached. The alteration is to install a spent fuel storage building to increase the storage capacities of both spent and new fuels from 200 to 800 spent fuel assemblies, and from 70 to 134 new fuel assemblies. The safety of the storage building is well confirmed.

50273 Physical tests in the KNK-II. Edelmann, M.; Hoppe, P. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik); Rohrbacher, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Reaktorentwicklung); Artz, D. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Projektbereich Kompakte Natriumgekuehlte Kernreaktoranlage); Blasius, D. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)); Olma, B.J. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). *KFK Nachr.;* **9**: No. 3, . 62-63(1977). (In German).

The following topics are included: (1) monitoring of the dynamic behaviour of the reactor and its internals; (2) detection of cooling disturbances developing in single fuel elements; and (3) investigation of the vibrational behaviour of the reactor tank and its internals.

50274 Design of FFTF shields. Bunch, W.L. (Hanford Engineering Development Lab., Richland, WA). pp 35-43 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

The Fast Flux Test Facility (FFTF) is to become the primary test facility in the United States for the development of liquid-metal-cooled, fast breeder reactors. Design philosophy for the facility was to place equipment in shielded cells to maximize the potential for maintenance. Dose rate criteria for each cell were coupled with design-basis radiation source strengths and equipment layouts to establish shielding requirements for each wall throughout the facility. High density concretes were employed to meet physical constraints established by the containment building. Point kernel calculations were made and documented for each wall and floor. Shield acceptance tests are planned to establish dose rates and radiation source strengths for comparison to design calculations.

50275 Evaluation of thermal stresses within a fast burst reactor: experimental analysis. Mulholland, G.P. (New Mexico State Univ., Albuquerque); De La Paz, A.; Luera, T. pp 181-184 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

A Fast Burst Reactor (FBR) is an unmoderated assembly of fissile material designed to be operated so that short duration, high intensity pulses of fission radiation are produced. A study was recently completed wherein computer codes were formulated for two situations; the first was a one-dimensional transient analysis for the general case of cylindrically symmetric surface heating and the second was a two-dimensional transient analysis for situations where moderating reflectors are used. The outputs provide the dynamic displacements and stresses that occur within the reactor. The purpose of the present investigation is to experimentally verify the above mentioned analytical study by measuring the radial displacement of the outer surface of the reactor. Results were obtained for a burst of 1.2 x 10^{17} fissions (300°C ΔT) having a pulse width of 39 μseconds and with the peak power being reached in 119 μseconds with no moderating reflector. The experimental results were found to be less than the results of the plane-strain analysis but greater than the free-plane-strain results. With this verification, the rim and axial stresses within the reactor can be predicted within the two limits.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

REFER ALSO TO CITATION(S) 49641

50276 Australian AEC plans HIFAR replacement. *Nucl. Eng. Int.;* **23**: No. 266, 30(Jan 1978).

Plans are outlined for a medium powered pool-type research and radioisotope production reactor complex as a possible replacement for the Australian reactor HIFAR. A simplified diagram is shown.

PROPULSION REACTORS

50277 Radiation streaming of N.S. Mutsu and its repair plan. Miyakoshi, J. (Japan Nuclear Ship Development Agency, Tokyo); Osanai, M.; Tsubosaka, A.; Miyasaka, S. pp 179-187 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

During the period September 1974—February 1975, a detailed investigation was undertaken on the neutron streaming from reactor shielding observed on board the N.S. Mutsu. Tests were carried out with the reactor at partial power (83 KWth = 0.23% of full rating, under which condition the radiation distribution was measured in the space outside the primary and secondary shields, for the purpose of determining the cause of the abnormal radiation observed during the preceding low-power tests. The results derived from these measurements, as well as analytical calculations, indicated that the abnormal radiation resulted from neutrons leaking out through the gap that existed between the pressure vessel and the primary shield. Based on the foregoing results, a plan has been adopted for modifying the shielding arrangement, by adding new shielding to close the gap referred to above and further supplementing and modifying both the upper and lower parts of the reactor shielding structure.

50278 Mock-up experiment and analysis for the primary shield of the Nuclear Ship Mutsu. Miyasaka, S. (Japan Atomic Energy Research Inst., Tokai); Asaoka, T.; Taji, Y. pp 188-196 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

A series of shielding mock-up experiments was performed at JRR-4, a swimming pool type reactor, of Japan Atomic Energy Research Institute (JAERI) to obtain the necessary experimental data and the sufficiently accurate method of calculation adopted for the modification of the Mutsu primary shield. Analyses for the experiments were carried out by using of the S/sub n/ codes, ANISN and TOWTRAN. The two dimensional calculations were performed with the P_1 - S_8 approximation. The neutron streaming through the annular gap between the pressure vessel and the primary shield has been confirmed to be estimated from the present method of calculation. The agreement between the calculated and the measured values is generally in about a factor of 2 to 4.

NUCLEAR SHIPS LICENSING AND REGULATION

50279 Question of right to stay of nuclear-powered vessels in foreign ports. Szafranek, J. *Tech. Gospod. Morsk.;* **26**: No. 5, 285-287(1976). (In Polish).

Question of right to stay of nuclear-powered vessels in foreign ports is considered in the light of London Convention on Safety of Life at Sea, Brussels Convention on Liability for Operation of Nuclear Ships and bilateral agreements.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 49720, 50860

50280 (ANL—78-28) **Viscosity of molten alumina.** Blomquist, R.A.; Fink, J.K.; Leibowitz, L. (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

In the analysis of LMFBR core-containment and heat-removal problems associated with hypothetical core-disruptive accidents, viscosity data on molten ceramics are needed to help analyze the convective heat transfer and flow patterns within liquid pools. An oscillating cup viscometer has been used to measure the viscosity of molten alumina in the temperature range from 2400 to 2750°K. The data are represented by the equation: log eta = 11448/T - 8.2734 where the viscosity, eta, is given in pascal seconds and the temperature, T, is in kelvins.

50281 (ANL-CT—78-26) **FTMOC-2D: a computer program for two-dimensional fluid-transient analysis by the method of characteristics.** Shin, Y.W. (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 133p. Dep. NTIS, MF A01.

Portions of document are illegible.

The computer program FTMOC-2D is a basic two-dimensional fluid-transient code that offers flexibility for application to a wide variety of problems. The flexibility is attained by requiring the user to provide a small part of the code to define the problem he wishes to solve. The basic numerical technique used is a two-step explicit procedure based on the method of characteristics. Use of four linearized bicharacteristic relations yields an efficient computational procedure for both the Cartesian and axisymmetric two-dimensional problems. The basic scheme is suitable for a fluid-structure interaction problem. The program structure is described in detail. Ease in use of the program is demonstrated by a sample problem calculation. Graphical display capability is also developed by which the calculated result is easily visualized.

50282 (ANL-RDP—69) **Reactor development program progress report, March 1978.** (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 156p. AT.

This progress report summarizes the Argonne National Laboratory work performed for the Reactor Development Program during March 1978 in the following research and development areas: Experimental Breeder Reactor No. II (EBR-II), Breeder-reactor Design Support, Instrumentation and Control, Fuels and Materials Development, Reactor Physics, Reactor Safety, and Other Fast Breeder Reactors.

50283 (EPRI-NP—618-SR) **Multi-fluid models for transient two-phase flow. Special report, June 1978.** Agee, L.J.; Duffey, R.B.; Banerjee, S. (Electric Power Research Inst., Palo Alto, Calif. (USA)). Nov 1977. 77p. Dep. NTIS, PC A05/MF A01.

The report describes the theory and research objectives associated with the development of advanced thermal-hydraulic models. Current state-of-the-art models based on RELAP type calculations have theoretical limitations which make them inapplicable to multi-dimensional, non-equilibrium, or slip flow conditions. These situations require advanced multidimensional or separated flow models which describe either the required spatial dimensions and/or utilize separate conservation equations for both the liquid and vapor phase of a two-phase fluid. The following topics are addressed in this report: (1) a summary of basic two-fluid theory, (2) some numerical and constitutive model considerations, (3) aspects of the experimental requirements for determining the necessary interphase transfer terms, and (4) the research objectives that must be attained for successful application of the advanced models to LWR analysis.

50284 (EPRI-NP—803) **WAMCUT, a computer code for fault tree evaluation. Final report.** Erdmann, R.C. (Science Applications, Inc., Palo Alto, Calif. (USA)). Jun 1978. 53p. Dep. NTIS, PC A04/MF A01.

WAMCUT is a code in the WAM family which produces the minimum cut sets (MCS) for a given fault tree. The MCS are useful as they provide a qualitative evaluation of a system, as well as providing a means of determining the probability distribution function for the top of the tree. The program is very efficient and will produce all the MCS in a very short computer time span. 22 figures, 4 tables.

50285 (GA-A—14758) **GCFR core auxiliary cooling system design study.** Khoe, J.H.; Leach, D.N.; Chung, H.S. (General Atomic Co., San Diego, Calif. (USA)). May 1978. Contract EY-76-C-03-0167-023. 213p. Dep. NTIS, PC A10/MF A01.

This report presents results from a General Atomic Company alternate design study for the core auxiliary cooling system (CACS) of the 300-MW(e) Gas-Cooled Fast Reactor (GCFR) Demonstration Plant. The purpose of this study was to evaluate CACS design concepts similar to that used in the large High-Temperature Gas-Cooled Reactor (HTGR), which has a non-boiling core auxiliary heat exchanger (CAHE) and CACS startup from rest. The study considers current 1977 safety criteria and requirements and includes design, transient analysis, drive and control trade-off studies, and analysis methods development. Transient analysis of the revised CACS design indicates satisfactory core cooling for all required operating conditions, according to current criteria.

50286 (LTR—141-67) **Fluid loads on LOFT DTT shrouds located in reactor vessel downcomer and DTT thermal loads during nuclear LOCE.** Kyllingstad, G. (Idaho National Engineering Lab., Idaho Falls (USA)). 2 May 1978. Contract EY-76-C-07-1570. 119p. (RE-A—77-029). Dep. NTIS, MF A01.

A thermal analysis was performed on a LOFT drag disc turbine (DTT) for a nuclear LOCE. Thermal gradients through the DTT shroud and turbine body, and temperature differences between body and shroud were calculated. This was done to determine the possible need for additional stress analyses of the DTT shroud to body welds based on thermal loads for a nuclear LOCE.

50287 (NUREG/CR—0080) **Critical experiments, measurements, and analyses to establish a crack arrest methodology for nuclear pressure vessel steels. Quarterly report, April—June 1977.** Hahn, G.T. (Battelle Columbus Labs., Ohio (USA)). Oct 1977. 58p. NTIS $5.25.

The governing equations for crack propagation and arrest in a cylinder under thermal and/or pressure stresses are derived and preliminary numerical tests of a computer algorithm that will eventually simulate the ORNL thermal shock experiments are presented. The basic computational procedure is found to be acceptable but a particular need for accurate propagating-crack fracture toughness (K/sub m/) input data is identified. To this end the test procedure has been successfully modified by the adoption of transverse wedge loading which substantially eliminates the errors due to extraneous load-point displacement. This test procedure is to be applied to a series of data-base materials, including A508-2 and A533B steel, as well as a submerged arc weldment. Composition, heat treatment, yield strength, and K/sub Ic/ values for these materials have been collected and are reported. The planning for irradiation has been completed.

50288 (SAND—78-0091) **Definition of loss-of-coolant accident radiation source: summary and conclusions.** Bonzon, L.L.; Lurie, N.A.; Houston, D.H.; Naber, J.A. (Sandia Labs., Albuquerque, N.Mex. (USA); IRT Corp., San Diego, Calif. (USA)). May 1978. Contract EY-76-C-04-0789. 190p. Dep. NTIS, PC A09/MF A01.

The radiation energy release rates and spectra corresponding to those sources specified in USNRC Regulatory Guide 1.89 for the radiation qualification of Class 1E equipment were calculated. The effects of several parameters (some not specific in the Guide), such as reactor fuel composition, operating duration and power level, and treatment of progeny, are evaluated. The results are presented as time-dependent beta and gamma-ray energy release rates and spectra which are fundamental quantities that are not specific to a plant design but are generally applicable to any nuclear power station.

50289 (TID—28436) **LOC-11A test rod damage: MacD-11-78.** MacDonald, P.E.; Broughton, J.M. (Idaho National Engineering Lab., Idaho Falls (USA)). 18 Jan 1978. Contract EY-76-C-07-1570. 29p. Dep. NTIS, PC A03/MF A01.

Measured LOFT cladding temperatures are discussed, a short review of the German fin cooling experiments is presented, the LOFT experimental and analytical evaluations of cladding surface thermocouple fin cooling are discussed at length, FRAP and MATPRO pressure and cladding ballooning calculations are presented, and it is concluded that the LOC-11 test rods probably did not experience significant plastic deformation.

50290 (TID—28481) **Quick look report on KKU support column air—water experiment (Series G2).** Mohr, C.M.; Jacoby, J.K. (Idaho National Engineering Lab., Idaho Falls (USA)). 1977. Contract EY-76-C-07-1570. 17p. Dep. NTIS, PC A02/MF A01.

The KKU support column air-water experiment is the second in a series of eight experiments designed to improve understanding of flow behavior in a pressurized water reactor (PWR) during the reflood phase of a loss-of-coolant accident. The upper plenum configuration in this test consists of a support column and an end box of KKU design. For the second KKU configuration, a total of 64 steady-state tests were performed during February and March 1978 to investigate counter-current flow limiting (CCFL) phenomena through the end box and upper core support plate. Based upon the results, it appears that the tests should be adequate for CCFL modeling. There could be a need for froth density data, however, so portions of this test series may need to be repeated after the gamma densitometer is installed. The observed flow behavior above the upper core support plate appears to be a turbulent froth, similar to those observed above sieve-type distillation plates.

50291 (TID—28482) **Quick look report on JAERI LSRT upper core support plate experiment (Series J-1).** Mohr, C.M.; Jacoby, J.K. (Idaho National Engineering Lab., Idaho Falls (USA)). 1978. Contract EY-76-C-07-1570. 22p. Dep. NTIS, PC A02/MF A01.

The JAERI large scale reflood test (LSRT), upper core support plate (UCSP) air-water experiment is the fourth in a series of eight experiments designed to improve understanding of flow behavior in a pressurized water reactor (PWR) during the reflood phase of a loss-of-coolant accident. The upper plenum configuration in this test consists of a proposed 4-hole UCSP for the JAERI LSRT 8x8 bundle arrangement. The KKU endbox was used in this experiment. For the J-1 configuration, a total of 78 steady-state tests were performed during March and April 1978 to investigate CCFL phenomena through the end box and upper core support plate.

50292 (TREE-NUREG—1215) **Experiment data report for LOFT nonnuclear Test L1-5 (isothermal test with Core 1 installed).** Jacoby, M.S. (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1978. Contract EY-76-C-07-1570. 298p. Dep. NTIS, PC A13/MF A01.

Test data are presented for Test L1-5, which was the fifth of five isothermal nonnuclear tests conducted by the Loss-of-Fluid Test (LOFT) Program. Test L1-5 was the first experiment conducted in LOFT with a nuclear core installed. The nuclear core was held in a shutdown condition. For Test L1-5 the LOFT facility was configured to simulate a loss-of-coolant accident in a large pressurized water reactor resulting from a 200% double-ended offset shear break in a cold leg of the primary coolant system. The initial conditions in the primary coolant system intact loop were: temperature 555 K, pressure 15.55 MPa (absolute), and intact loop flow 176.1 kg/s. During system depressurization into a simulated containment, emergency core cooling water was injected into the primary coolant system cold leg to provide data on the effects of emergency core cooling on system thermal-hydraulic response.

50293 (WCAP—7832-A) **Evaluation of steam generator tube, tube sheet, and divider plate under combined LOCA plus SSE conditions.** De Rosa, P.; Rinne, W.; Massie, H.W. Jr.; Mitchell, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Apr 1978. 240p. Westinghouse Electric Corp., Pittsburgh, PA.

The report describes the structural analysis of tubes, tubesheet, and divider plate of 51-Series and Model D Westinghouse steam generators when subjected to combined loss-of-coolant accident (LOCA) and safe shutdown earthquake (SSE) loading. The objective of this analysis was to demonstrate that the maximum stresses in these components fall within ASME B and PV Code Section III allowable limits when subjected to these loading conditions.

50294 **Travelling-wave-induced instability of structures.** Farshad, M.; Tadjbakhsh, I. (Pahlavi Univ., Shiraz, Iran). *J. Franklin Inst.;* **305**: No. 6, 343-350(Jun 1978).

The effect of transmission time of propagating disturbances on the dynamic instability of structures is discussed in this paper. Through a parametric study it is shown that for certain values of transmission time and wave frequency parameters, the structure may become dynamically unstable. An example is worked out, and graphical results depicting the regions of instability are presented.

50295 **Verification of the TRAC code on RSR standard problem 5.** Bolstad, J.W. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 390-391(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50296 **TRAC calculations of ECC bypass phenomena in a 1/15-scale experimental facility.** Williams, K.A.; Liles, D.R. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 391-392(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50297 **Effects of bottom injection location on reflood characteristics.** Addabbo, C.; Chon, W.Y.; Liao, N.S. (State Univ. of New York, Albany). *Trans. Am. Nucl. Soc.;* **28**: 392-393(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50298 **Upper plenum LPIS injection in the semiscale MOD-1 system.** Harvego, E.A.; North, P.; Loomis, G.G. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 393-394(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50299 **UCFLOOD: a code for bottom reflooding heat transfer in LWRs.** Arrieta, L.A.; Yadigaroglu, G. (Univ. of California, Berkeley). *Trans. Am. Nucl. Soc.;* **28**: 394-395(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50300 **Analysis of a LOCA for a consolidated nuclear steam system.** Mueller, G.E.; Sanders, R.C. (Univ. of Missouri, Rolla). *Trans. Am. Nucl. Soc.;* **28**: 395-396(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50301 **RELAP4/MOD7/Version 1 BWR spray cooling calculations compared with data.** McCreery, G.E.; Hendrix, C.E. (EG and

G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 396-397(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50302 Heat transfer in the inverted annular flow regime during reflooding. Goodman, J.; Elias, E. (Science Applications, Inc., Palo Alto, CA). *Trans. Am. Nucl. Soc.;* **28**: 397-399(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50303 Steady-state and transient CHF measurements in freon-11: with particular reference to PWR conditions. Leung, J.C.M.; Henry, R.E. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 400-401(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50304 Application of drift flux to transient two-phase level swell. Ward, L.W. (Combustion Engineering, Inc., Windsor, CT). *Trans. Am. Nucl. Soc.;* **28**: 401-403(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50305 Effect of subcooled critical flow discharge model on hydrodynamic loads during a LOCA. Schneider, R.E.; Whipple, R.C. (Combustion Engineering, Inc., Windsor, CT). *Trans. Am. Nucl. Soc.;* **28**: 403(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50306 Effect of rod external thermocouple simulators on steady-state and transient CHF. Gottula, R.C.; Eide, S.A.; Howe, T.M.; Tolman, B.L. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 403-405(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50307 PCRV integrity during HTGR core heatup. Wakefield, D.J.; Dunn, T.D.; Silady, F.A. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **28**: 405-406(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50308 Film entrainment determination for containment subcompartment flows. Koestel, A.; Gilbert, J.S.; Gido, R.G. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 406-407(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50309 Superheated containment atmosphere heat/mass transfer to passive heat sinks. Frank, S.; Hynek, S.J.; Stauder, J.W. (Stone and Webster Engineering Corp., Boston). *Trans. Am. Nucl. Soc.;* **28**: 408-409(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50310 ALICE: a hybrid Lagrangian—Eulerian code for containment analysis. Chu, H.Y. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 409-411(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50311 Comparison of CONTEMPT-LT calculations with Marviken experiments. Willcutt, G.J.E.; Gido, R.G. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 412(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50312 Containment accident analysis using CONTEMPT4/MOD2 compared with experimental data. Metcalfe, L.J.; Hargroves, D.W.; Wells, R.A. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 412-414(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50313 Post-accident filtration design for PWR and BWR containments. Gossett, B.; Simpson, M.; Cave, L.; Chan, C.K.; Okrent, D.; Catton, I. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.;* **28**: 414-415(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50314 Vacuum relief valve sizing in condensing steam situations. Ashley, G.K. II; Howard, N.M. (Bechtel Power Corp., San Francisco). *Trans. Am. Nucl. Soc.;* **28**: 415-416(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50315 Numerical simulation of BWR vent clearing hydrodynamics. Nichols, B.D.; Hirt, C.W. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 416-417(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50316 Some considerations in small-scale pool swell simulations. Anderson, W.G.; Huber, P.W.; Snyder, D.A.; Sonin, A.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 417-418(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50317 Acceleration forces generated by an oscillating air bubble. Tung, C. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **28**: 418-419(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50318 Effect of geometric parameters on downward forces during vent clearing. Chiou, H.H.; Dhir, V.K.; Catton, I. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.;* **28**: 419-420(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50319 Development of a revised ANS standard on decay heat from fission products. Schrock, V.E. (Univ. of California, Berkeley). *Trans. Am. Nucl. Soc.;* **28**: 421-422(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50320 Behavior of previously failed PWR fuel rods under power ramp and film boiling operation. Croucher, D.W.; Hobbins, R.R.; Quapp, W.J. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **28**: 424-426(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50321 Simple multichannel thermal-hydraulic model for study of the transient behavior of coolant in LMFBR subassembly. Chen, W.L.; Ishii, M.; Grolmes, .A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 429-430(Jun 1978).
From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).
See CONF-780622—.

50322 Fuel pin coolability in low power voiding. Dunn, F.E. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 430-431(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50323 SAS3D prediction of intrasubassembly boiling incoherence. Dunn, F.E. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 431-432(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50324 Establishment of buoyancy-induced natural circulation in loop-type LMFBRs. Khatid-Rahbar, M. (Brookhaven National Lab., Upton, NY); Cady, K.B. *Trans. Am. Nucl. Soc.;* **28**: 432-433(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50325 Experimental and analytical study of transients in LMFBR outlet plenums. Carbajo, J.J. (Univ. of Illinois, Urbana); Howard, P.A. *Trans. Am. Nucl. Soc.;* **28**: 433-434(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50326 Hydraulic tests on an inherent secondary shutdown assembly for LMFBRs. Specht, E.R.; Paschall, R.K.; Chung, D.K.; Jackola, A.S. (Atomics International, Canoga Park, CA). *Trans. Am. Nucl. Soc.;* **28**: 435-436(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50327 Calculations of steam worth in a GCFR lattice. Schaefer, R.W. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 772-773(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50328 Experimental study of reactivity worths of simulated LMFBR meltdown configurations. Bhattacharyya, S.K.; Smith, D.M.; McKnight, R.D.; LeSage, L.G. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 786-788(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50329 Seismic tests. Lai, Y.S. (Dresser Ind). *Power Eng.;* **82**: No. 2, 60-61(Feb 1978).

Two vibration tests of a Q-orifice yoke rod constructed spring-loaded safety valve were conducted to study its dynamic behavior. In the first test, the safety valve was subjected to an excitation covering a range of frequencies, while in the second series of tests, the safety valve was subjected to a constant sinusoidal excitation. The test results indicate that a series of tests in one horizontal direction only should be sufficient to determine the natural frequencies and the seismic operability of ASME Section III spring-loaded safety and relief valves.

50330 Development of seismic design criteria for category I cofferdams. Chakrabarti, S.; Husak, A.D.; Christiano, P.P.; Troxell, D.E. (D'Appolonia Consulting Engineers, Inc., Pittsburgh, Pa. (USA)). *Nucl. Eng. Des.;* **45**: No. 1, 277-283(Jan 1978).

Static methods of cofferdam design have become somewhat standardized and have been verified through observations of performance. A promising approach to the seismic design of such structures is centered about the development of consistent pseudo-static failure mechanisms. This paper illustrates such extensions of the static design techniques, and compares the factors of safety obtained from static and pseudo-static (seismic) analyses. Certain design criteria, which have been modified to account for dynamic action, are explained. Local soil, rock and hydrostatic conditions, liquefaction and hydrodynamic forces are considered.

50331 Automated generation of spectrum-compatible artificial time histories. Kost, G.; Kamil, H.; Gantayat, A. (Engineering Decision Analysis Company, Inc., Palo Alto, California, USA); Tellkamp, T.; Weber, F. (Kraftwerk Union A.G., Offenbach (Germany, F.R.)). *Nucl. Eng. Des.;* **45**: No. 1, 243-249(Jan 1978).

Criteria for the seismic design of nuclear power plants are usually defined in the form of response spectra, and it is often necessary to generate artificial time histories of ground motions to 'match' these spectra. A recently developed automated iterative procedure employing a combination of frequency- and time-domain techniques in any desired sequence for the development of spectrum-compatible artificial time histories is presented. The procedure employs four basic steps: (1) generation of an initial (starting) time history using either sinusoidal superposition with an envelope function or specification of a real time history of a recorded ground motion; (2) manipulation of the amplitude and phase of the Fourier transform representation of this time history, and generation of successive time histories which have response spectra converging to the target design spectrum; (3) manipulation of the amplitude and phase of the Fourier transform representation only locally in areas where the peaks of the computed spectrum have larger magnitudes of deviations than desirable; and (4) manipulation of local areas of the latest time history. Computer program EDAC/SEQGEN, which completely automates the above steps, is described.

50332 Analytical simulations in the field of two-phase-flow. An overview of present state and future necessities. Karwat, H.; Werner, W.; Wolfert, K. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching/Muenchen (Germany, F.R.)). *Atomkernenergie;* **31**: No. 1, 7-15(1978).

The analytical simulation of two-phase-flow phenomena is a very important tool in determining the design basis of engineered safeguards in the field of reactor technology. Specific areas of interest are the simulation of loss-of-coolant accident events, operational transients, and anticipated transients without scram (ATWS). Fluid dynamic parameters of interest are, in general, surface conditions of structures in terms of specific mass flow rates and local enthalpies, as well as pressure distributions to determine forces which may affect the geometry of structures. In some cases (e.g. pressure suppression systems) mixing effects under non-equilibrium conditions such as bubble collapse influence fluid-structure interactions which are considered to be important boundary conditions for the design of these structures.

50333 Earthquakes, faults, and nuclear power plants in southern New York and northern New Jersey. Aggarwal, Y.P. (Observatory of Columbia Univ., Palisades, NY); Sykes, L.R. *Science;* **200**: No. 4340, 425-429(1978).

Seismic activity in the greater New York City area is concentrated along several northeast-trending faults of which the Ramapo fault appears to be the most active. Three nuclear power plants at Indian Point, New York, are situated close to the Ramapo fault. For a reactor site in use for 40 years, the probability that the site will experience an intensity equal to or in excess of the design (safe shutdown) earthquake is estimated to be about 5 to 11 percent.

50334 Stationary system for monitoring local dose rates within nuclear power plants. Draft version 10/77. *Bundesanzeiger;* **29**: No. 234, 1(Dec 1977). (In German). (KTA—1501).

The rule contains requirements to be met by the system. It determines the measurement problem and stipulates requirements concerning measuring points, measuring layout, breakdown and danger notification system, recording and registration of measuring values as well as documentation, special constructions of equipment for measurements during and after incidents, maintenance and repair, as well as inspections. The rule applies to the stationary system for monitoring local dose rates in all those radiation protection areas of stationary nuclear power plants where the local dose rate does not exceed 3 m 7/kg h (0.3 rem/h) under normal operating conditions.

50335 Methods for safety assessment of the power plant units of the NORDEL group. Gladysev, G.P.; Gorin, V.I.; Jakovlev, G.G. *Arch. Energiewirtsch.;* **31**: No. 12, 1017-1023(Dec 1977). (In German).

The safety of power plants in all NORDEL member states is assessed according to a standard methodology. The statistical data on power plant operation are collected on special standard forms. These forms give the time intervals of equipment operation, the reserves, and the duration of all outages.

50336 Basic recommendations for disaster control in the area of nuclear facilities. Conclusions by the Laenderausschuss fuer Atomkernenergie and the authorities of the interior of the Laender dated 10/11th March 1975. *Gemeinsames Ministerialbl., A;* **28**: No. 31, 683-718(Dec 1977). (In German).

The Federal government and the Laender governments have established these basic recommendations in order to harmonize the local emergency plans of the operators and the disaster control plans of the authorities which are required not only for nuclear facilities but for all facilities with a certain hazard potential, while giving special attention to the danger of radiation as a special factor. Contents: A. Relation between the planning by the authorities and the measures taken by nuclear power plant operators. B. Basic pinciples for the establishment of special disaster control plans for

the neighbourhood of nuclear facilities: I. General; II. Lay-out and classification of the special disaster control plans: 1. contents, 2. continuation record, 3. disaster control management, 4. graphical, schematic representations of alarm systems, 5. collecting point and marking of the personnel employed, 6. subdividing the neighbourhood of a nuclear facility, 7. alarm stages, 8. survey of alarm measures. C. Explanation of the alarm measures: 1. giving the alarm, 2. employment of the measuring service, measurements, 3. informing the population, 4. traffic control, 5. distribution of iodine tablets, 6. evacuation, 7. giving warning to downstream water collecting centres, 8. decontamination. D. Annex to the special disaster warding-off plans. E. Preparatory measures of the disaster control authority. Annex: Radiological principles for the planning of emergency protection measures.

50337 Amendment of the recommendations concerning the planning of emergency provisions by the operators of nuclear power plants. Dated from October 18, 1977. *Gemeinsames Ministerialbl., A;* **28**: No. 30, 664(Dec 1977). (In German).

Amendment of section B No. 4c) 'fire alarm', and annex 9, tables 1 and 2 'cow's milk samples', in particular concerning I^{131}.

50338 Ricerca sul sistema di contenimento a soppressione di pressione. I. Research on the pressure suppression containment system. I. Marinelli, M.; Mazzini, M. (Univ di Pisa, Italy). *Termotecnica (Milan);* **31**: No. 12, 610-622(Dec 1977). (In Italian).

This paper shows the outlines of a research program on the behavior, after a loss of coolant accident, of the pressure suppression containment system used in the BWR plants. The experimental facility setup at the Nuclear Engineering Institute of the Pisa University is described and the results obtained during the first set of tests are reported. The analysis of these results leads to some interesting conclusions which not only confirm the validity of the research program but also suggested its enhancement. 13 refs.

50339 Solving safety problems in nuclear power station practice. Eitz, A.W. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.). Abt. Kraftwerksanlagen); Watzel, G.V.P. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.). Abt. Kraftwerksanlagenbau - Kerntechnik). *At. Strom;* **23**: No. 6, 141-148(Nov 1977). (In German).

On the basis of the legal requirements for reactor safety and the practice of official supervision the authors attempt to describe the safety procedure in the layout of light-water reactors. They describe the safety strategy and the safety principles applied in the layout. Next the authors deal with the successes achieved with this method in nuclear power station practice, on the one hand in the studies on quantitative risk evaluation (e.g. the Rasmussen study) and on the other hand in the reliability and availability of the nuclear power stations which are now in operation.

50340 Local sodium boiling behind local flow blockage in simulated lmfbr fuel subassembly. Kikuchi, Y.; Daigo, Y.; Ohtsubo, A. (Power React and Nucl Fuel Dev Corp, Ibaraki-ken, Jpn). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 11, 774-790(Nov 1977).

The paper deals with local sodium boiling in the downstream of a six-subchannel blockage in an electrically heated LMFBR fuel subassembly mock-up. The first series of experiments were conducted to measure temperature distributions in the downstream of the blockage under nonboiling conditions. The measured temperature rise due to the blockage agreed fairly well with the calculation by the LOCK code. The second series of experiments were performed to investigate local boiling phenomena. In the local boiling region, no flow instability was observed since the subchannels near the wrapper wall were still filled with subcooled liquids. The boiling caused a considerable increase in acoustic noise intensity. The frequency (2.9 and 20.2 sec$sup -1$) of bubble formation decreased with the increase of the bubble size at its point of maximum development. The product of the bubble frequency and the equivalent diameter was found to be constant. 7 refs.

50341 Subassembly experiments and a computer code to analyze the dynamic core deformation during local failure propagation. Liebe, R. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 353-371(Sep 1977).

Safety investigations for LMFBRs have to consider local failure situations in one fuel element which may escalate to a hypothetical CDA. Such initiating events could produce high pressure pulses in a single subassembly which may expand and rupture the wrapper as well as load adjacent elements impulsively. The associated nonlinear dynamic core deformation problem is treated in this paper. In particular the multirow structural dynamics code COERE-1 and underlying mechanical models are described. Each subassembly is simulated by an equivalent system of point masses and nonlinear coupling springs. The motion of the coolant layer between the elements is treated by an incompressible, non-stationary frictional flow model. In order to obtain realistic code input four types of static single subassembly deformation experiments are described which provided strongly nonlinear load deformation characteristics.

50342 Dynamic response of a clamped/ring-stiffened circular cylindrical shell under non-axisymmetric loading. Ludwig, A.; Krieg, R. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 437-453(Sep 1977).

In order to investigate the structural integrity of light water reactors in case of a blowdown accident the reactor core barrel is modeled as a linear-elastic thin walled circular cylindrical shell, clamped at the upper end and ring-stiffened at the lower end. A computer code CYLDY2 has been developed for analysis of the dynamic response of sych shells. The mathematical model on which the code CYLDY2 is based is described in some detail. The transient shell deformations are represented by sets of orthogonal modal functions and the appropriate amplitudes are determined by variational principles. Test calculations confirm that the spatial resolution provided by CYLDY2 is satisfactory even for peak types of loadings having a peak width smaller than 1/10 of the cylinder length and that the computer time is by one or two orders of magnitude smaller than the computer time required for application of well known finite element codes.

50343 Sample calculations on fuel rod behavior during a LOCA with the code system SSYST-MOD 1. Meyder, R.; Raff, S.; Sengpiel, W. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). *Nucl. Eng. Des.;* **43**: No. 2, 455-462(Sep 1977).

The present paper shows results generated with SSYST, a program system developed for the analysis of the LWR fuel rod behaviour during a LOCA. A blowdown experiment in an out-of-pile test facility is analysed. The aim of the calculations is to demonstrate the influence of the various separate models, each describing a particular phenomenon such as rod internal pressure or rod mechanics on the behaviour of a hot rod by switching on these models sequentially. Calculations showed that the models presently included in the SSYST-system are able to describe the thermal and mechanical rod behaviour qualitatively in a correct way and that they may well be used to analyse the rod behaviour in a LWR during a LOCA.

50344 Model for formation and growth of local blockages in grid spaced fast sodium cooled breeder fuel elements. Schultheiss, G.F. (Karlsruhe Univ. (TH) (Germany, F.R.). Inst. fuer Reaktortechnik). *Nucl. Eng. Des.;* **43**: No. 2, 329-341(Sep 1977).

The studies of the formation of local cooling flow disturbances in fast sodium breeder reactors are intended to furnish information, which can be used for safety assessments, about the attainable extent of blockages and the time required for their growth. The formation of major local blockages in normal fuel element geometries will mainly be caused by fuel expelled after a cladding tube failure. A model of the screening process is developed considering the results of in-pile experiments, thermohydraulic studies and simulation experiments of the growth of blockages. The model is limited to the initial phase in which the largest free cross sections in a subchannel with a spacer grid geometry must be plugged up to constitute a so-called 'fundamental blockage'. Parameter studies on the model show that events constituting the formation of a blockage occur slowly.

50345 Pressure bursts due to power channel explosion in a pressure tube reactor. Famiglietti, M.; Galbiati, L.; Parmeggiani, A.; Possa, G. *Arch. Energiewirtsch.;* **31**: No. 8, 694-702(Aug 1977). (In German).

In the determination of the safety criteria of channel reactors with heavy-water moderator, the main assumption is that ruptures of pressure tubes in the power channel are preceded by coolant leakage. Still, even extreme error conditions are usually taken into account in design practice. Above all, it must be found out what happens in case of sudden tube rupture in the power channel.

50346 Seismic risks analysis for nuclear power plants. Gulkan, P.; Yucemen, S.M. (Middle East Technical Univ., Ankara (Turkey)). *Middle East Tech. Univ. J. Pure Appl. Sci.;* **10**: No. 1, 115-135(1 Apr 1977).

Recent developments in seismic risk evaluation are reviewed with the objective of application to a particular site under consideration for a nuclear power plant. Numerical results obtained from a refined analysis are presented for the site in question.

50347 Civil nuclear power : technological and socio-political risks. Jaishankar, S.; Raja Mohan, C. (Jawaharlal Nehru Univ., New Delhi (India). School of International Studies). *Inst. Def. Stud. Anal., J.;* **9**: No. 3, 237-255(1977).

Concern is voiced over the irresponsible use of nuclear technology and also the unavoidable accidents in nuclear reactors at the global level. The problems posed by radioactive pollution either by release of radioactivity to the atmosphere or the ecological pollution resulting in long-term storage of radioactive wastes underground are

discussed. Some figures are quoted to illustrate the possible damages to environment and population.

50348 Radiation exposure and protection problems in nuclear power plants: US overview. Verna, B.J. (Nuclear Power Experience, Inc., Encino, CA). pp 288-299 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

The author expresses a concern that situations may occur where plants could not obtain sufficient maintenance personnel with unused exposure possibilities to complete repair efforts. The restrictions imposed by the ALARA criteria and the exposure limits are discussed. The possibility of even lower limits is brought up. Exposure experience is presently running at approximately 500 man-rem/unit/year. Examples of radiation levels at various locations in the plants, and typical radioactive maintenance problems are presented. Means to control the formation and deposition of activated corrosion products are discussed.

50349 Seismic instrumentation of U.S. nuclear power plants. Pauly, S.E. pp 207-211 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Regulatory Guide 1.12 on earthquake instrumentation criteria for nuclear power plants is reviewed. Systems that meet the criteria are discussed under the following headings: installation, time history acceleration system, seismic switch and switch accessory panel, response spectrum recorder, peak accelerograph, maintenance and data reduction, and post event analysis.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 49905, 50456

50350 (BNL—24473) Method for the comparative economic assessment of storage systems. Davitian, H.; Leigh, R.W. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 4p. (CONF-780801—19). Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A method for the comparative economic evaluation of various energy storage devices in a given application is described. The method is particularly useful in examining the economics of devices with short lifetimes and can be employed whenever a device lifetime can be expressed as a function of physical parameters which are related to the manner in which the device is used. Given a detailed description of the pattern of use of the device in the application, the device lifetime can be calculated. The economic consequences of changes in lifetime result from the dependence of the capital recovery factor on device lifetime. It is shown how analyses can be made of changes in technical performance characteristics or changes in the pattern of use of the storage device to determine their effects upon the annual cost of energy storage and to determine minimum cost systems.

50351 (COO—4454-4) Program evaluation and review system for the Division of Energy Storage Systems. Progress report, January 1, 1978—March 31, 1978. Wechsler, B.L. (Lehigh Univ., Bethlehem, Pa. (USA)). Apr 1978. Contract EC-77-S-02-4454. 161p. Dep. NTIS, MF A01.

Portions of document are illegible.

The detail design for SPERS has been completed with the exception of STORS user inputs to that design. Programming activities for the system have been started but the project is now some three weeks behind schedule in this respect. Details of the in-process review held in February are included in an appendix. The first report on this program is COO/4454-1 and appears in ERA Vol. 3 Abstract No. 29976.

50352 (UCRL—81159) Evaluated physical properties data for materials used in energy storage systems. Hampel, V.E.; Gevantman, L.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.; National Bureau of Standards, Washington, D.C. (USA). Office of Standard Reference Data). May 1978. Contract W-7405-ENG-48. 25p. (CONF-780587—1). Dep. NTIS, PC A02/MF A01.

From 6. CODATA conference; Palermo, Italy (22 May 1978).

Accurate material properties in support of RD and D in energy storage are a prerequisite for cost-effective decision making of system design and market penetration. This requirement in a relatively old field, but now under renewed emphasis, has brought about since 1976 a unique arrangement for data evaluation and dissemination: The Lawrence Livermore Laboratory (LLL), under contract to the Division of Energy Storage Systems of the U.S. Department of Energy (DOE/STOR), identifies materials and properties required for batteries, flywheels, and for thermal or chemical systems. The users of these data set the priorities for evaluation. Requests are forwarded to the Office of Standard Reference Data of the National Bureau of Standards (NBS/OSRD) which selects and engages other sources of expertise. In addition, OSRD manages and monitors the output of data evaluations prior to their being published as part of the NSRD/NBS series, and prior to their being stored on a PDP-11/70 mini-computer for subsequent assess through the Integrated Information System (IIS) at LLL. Administrators of DOE/STOR, researchers, engineers and DOE contractors can thus assess the physical properties in a selective, concise, and up-to-date manner on demand over the ARPAnet and by telephone dial-up from remote terminals nationwide.

MAGNETIC

REFER ALSO TO CITATION(S) 51622

50353 (LA—7312-P) Proposed 30-MJ superconducting magnetic energy storage unit for stabilizing an electric transmission system. Boenig, H.J.; Bronson, J.C.; Colyer, D.B.; Hassenzahl, W.V.; Rogers, J.D.; Schermer, R.I. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1978. Contract W-7405-ENG-36. 36p. Dep. NTIS, PC A03/MF A01.

Electric power systems that have major loads and generation centers separated by large distances may experience low-frequency power oscillations. This type of oscillation has occurred on the Pacific AC Intertie that connects southern California and the Pacific Northwest. A separate, almost parallel, dc-transmission line also connects these areas. The Bonneville Power Administration, which operates this transmission system, has overcome the instability by controlling the power transmitted on the dc-transmission line. The power variations on the dc line are about 5 MW. Studies at the Los Alamos Scientific Laboratory and the Bonneville Power Administration show that a 30-MJ (8.4-kWh) superconducting magnetic energy storage (SMES) unit with a 10-MW converter could provide similar damping for the instability. The Los Alamos Scientific Laboratory's conceptual design of the 30-MJ coil and the cryogenic and electronic components of the system are described.

COMPRESSED GAS

50354 (PNL—2443) Stability and design criteria studies for compressed air energy storage reservoirs. Progress report, FY 1977. Smith, G.C.; Stottlemyre, J.A.; Wiles, L.E.; Loscutoff, W.V.; Pincus, H.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1978. Contract EY-76-C-06-1830. 211p. Dep. NTIS, PC A10/MF A01.

Progress made during FY-1977 in establishing design criteria to ensure the successful operation and long-term stability of Compressed Air Energy Storage (CAES) reservoirs in underground porous media, such as aquifers is summarized. The formulation of pertinent criteria is important since the long-term stability of air storage reservoirs is probably the item of greatest risk to the successful demonstration and commercialization of the CAES concept. The study has been divided into four phases: (1) state-of-the-art survey, (2) analytical modeling studies, (3) laboratory studies, and (4) field testing. The first of these phases, the state-of-the-art survey for air storage in porous reservoirs, has been completed on schedule and is reported in Section 2. Sections 3 and 4 are progress reports on Phases 2 and 3. No work has been done on Phase 4. It is planned that the field testing phase of this study will be carried out in conjunction with the Department of Energy/Electric Power Research Institute (DOE/EPRI) CAES Demonstration Program. This phase is not scheduled to begin until FY-1979.

PUMPED HYDRO

50355 Pumped-storage power station. Jaskiewicz, J. *Energetyka;* **32**: No. 5, 188-189(May 1978). (In Polish).

50356 Particularities of the hydroelectric power plants, of the pump and turbine accessories of Japanese pumped-storage plants. Derzko, M.V. *Arch. Energiewirtsch.;* **32**: No. 3, 179-187(Mar 1978). (In German).

At present, there are 20 pumped storage power plants with an overall capacity of about 6 GW in operation in Japan; another 10 large-scale facilities with an overall capacity of some 9 GW are under construction, and they will take up operation around 1980. Japanese pumped storage power plants are characterized by a relatively high individual power.

50357 Pumped-storage power stations as multi-purpose installations for developing countries. Boerner, R. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Hydraulik und Hydrologie). *Elektrizitaetswirtschaft;* **77**: No. 4, 136-139(Feb 1978). (In German).

Anxieties about national energy supply should not divert attention from problems abroad. The author presents the possible use of the pumped-storage power station, which is known to be satisfactory in industrial countries, as a multipurpose installation in developing countries. There pumped storage, in addition to solving problems with the water economy, presents a new and wide field of application and it is hoped that this will soon be achieved for the wellbeing of these countries.

50358 Pumped-storage plants in the socialist countries of Europe. Derzko, M.V.; Derzko, R.M. *Arch. Energiewirtsch.;* **32**: No. 2, 99-108(Feb 1978). (In German).

The article describes, in detail and with tables, a) the underground pumped-storage plant near Markersbach/GDR, b) the Zarnovek pumped-storage plant in North-West Poland, c) the pumped-storage plant now under construction in Dalesice, Czechoslovakia, which will be operated in combination with an 800 MW nuclear power plant, d) the high-power pumped-storage plant now under construction in Tschaira, Bulgaria, and e) the high-pressure pumped-storage plant at Bajina Basta, Yugoslavia, which will soon be completed. There is also a table which lists all pumped-storage plants in operation, under construction, and in the planning stage in the socialist countries of Europe (with the exception of the USSR).

50359 Recent export reversible pump-turbines. Takahashi, J.; Harada, K. *Toshiba Rev., Int. Ed.;* No. 114, 5-9(1978).

A description is given of the design and construction of several reversible pump-turbines used at various pumped-storage hydroelectric power plants. Some recent technical achievements include: (1) automatic design by computer; (2) computerized prototype testing; (3) sealing system for reduced water leakage; and (4) smooth air-exhaust system for pump starting. The operation of the pump-turbines at various installations is discussed. (PMA)

50360 Single phase synchronous machines of the Langenprozelten pumped storage plant. Gaeng, D.; Schneider, W.; Haase, G. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Berlin (Germany, F.R.)); Bartsch, M. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Frankfurt am Main (Germany, F.R.)). *Elektr. Bahnen;* **47**: No. 2, 39-43(1976). (In German).

The two single phase synchronous machines of the pumped storage plant with an output of 94 MVA each for the $16^{2}/3$ Hz electric train power supply are the largest power single phase synchronous machines for electric train power supply in the world at present. The electrical and constructional features of these machines are described.

FLYWHEELS

50361 For the latest in energy storage, try the flywheel. Chang, G.C.; Hirschfeld, F. (US ERDA, Washington, DC). *Mech. Eng.;* **100**: No. 2, 38-45(Feb 1978).

From regenerative braking in automobiles to peaking power for utility operations, the flywheel has become a key element in developing primary and hybrid systems for energy storage. Using new composite materials, together with other sophisticated engineering components, the flywheel has been redesigned to meet the needs of an oil-shortage economy. The most immediate applications are in transport vehicles, but there are other promising uses ahead in utilities, solar power, and wind turbine facilities. The direction of research on the flywheel itself, its capability for reducing fuel consumption in gasoline vehicles, the load on the battery in electric vehicles, and the possibility of an all-flywheel-powered electric vehicle are discussed.

50362 Optimal design of anisotropic (fiber-reinforced) flywheels. Christensen, R.M.; Wu, E.M. (Lawrence Livermore Lab., CA). *J. Compos. Mater.;* **11**: 395-404(Oct 1977).

An analysis is given of the kinetic energy storage capacity of anisotropic flywheels. Using a uniform strain failure criteria, the optimal shapes of flywheels are determined as a function of the degree of anisotropy. Within this spectrum of shapes, practical design considerations are shown to favor the case where there is equal reinforcement in the radial and circumferential directions. Comparisons are made between the present solid-wheel-type design and the ring design.

THERMAL

REFER ALSO TO CITATION(S) 50573

50363 (SAND—78-8672) **Specific heat variations in oil energy storage media and their economic implications.** Carling, R.W.; Radosevich, L.G. (Sandia Labs., Livermore, Calif. (USA)). Jun 1978. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

Hydrocarbon oils have been considered for use as thermal energy storage media in solar thermal electric systems. In systems storing the energy as sensible heat, the energy storage capacity is determined by the specific heat of the oil. Among the oils proposed is Caloria HT-43, a product of Exxon Corporation. Previously reported specific heat data on Caloria HT-43 show values differing by as much as 25 percent. An attempt was made to resolve this discrepancy by measuring the specific heat from 77 to 327°C. Results show values from four samples varying by as much as 11 percent. The variations are correlated with differences in average molecular weights and inhomogeneity of the samples. The impact on cost of an 11 percent variation in specific heat is less than 1 percent for oil/rock systems and less than 2 percent for an all-oil system.

CHEMICAL

50364 Heat storage in the magnesium-hydrogen system. Rummel, W. (Siemens, Erlangen, Ger). *Siemens Forsch.- Entwicklungsber.;* **7**: No. 1, 44-50(1978). (In German).

The possibility of storing heat in the form of latent heat (reaction enthalpy) and of releasing this heat by reaction of two components by the decomposition of metal hydrides is demonstrated by way of example of magnesium and hydrogen. The storage cycle which, in the example discussed, takes place between 600 K and a maximum of 800 K, is described by an energy-flow diagram. The estimated efficiency of heat recovery under the most unfavorable conditions is about 60%. If the sensible heat of storage can be utilized in addition to the latent heat, efficiencies over 85% can be obtained. The possibilities of further improving the efficiency and of a better utilization of the energy are dealt with.

BATTERIES

50365 Primary batteries: recent advances. Graham, R.W. Park Ridge, NJ; Noyes Data Corp. (1978). 379p.

The information in this book is taken from U.S. patents dealing with primary batteries and their commercial technology that were issued since the autumn of 1975. The book both supplies detailed technical information and is a guide to U.S. patent literature in this field. The following topics are covered: zinc dry cells (electrodes, separators, electrolytes, corrosion inhibitors, sealing and leak prevention, venting and pressure control, thin cells, other processes); silver oxide—zinc, air—zinc, and other batteries (divalent silver oxide—zinc, silver peroxide—zinc, watch battery design, air—zinc systems, other battery processes); lithium nonaqueous-electrolyte systems (lithium—fluorinated carbon, lithium—carbon, electrolytes, anode components, cathodes, general processes); sodium and lithium solid-electrolyte systems (sodium—halogen, lithium); seawater, reserve, thermal, and similar batteries; and batteries for pacemakers and film packs (pacemakers--general, pacemakers--biofuel cells, flat cells for photographic applications). Company, inventor, and patent number indexes are provided. (RWR)

50366 Power sources 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977). 807p. (CONF-7609175—). $70.25.

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

A separate abstract was prepared for each of 34 papers presented at this conference. The remaining 14 dealt with primary batteries and did not fall within the subject scope of ERA. (RWR)

DESIGN AND DEVELOPMENT

50367 (UCRL—81178) **Mechanically rechargeable, metal—air batteries for automotive propulsion.** Cooper, J.F.; Littauer, E.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Lockheed Missiles and Space Co., Palo Alto, Calif. (USA)). 26 May 1978. Contract W-7405-ENG-48. 8p. (CONF-780801—8). Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A systems study is reported concerning the application of mechanically refuelable, metal—air batteries to electric vehicle propulsion. The batteries are refueled by the addition of anode plates and water, while the reaction product is withdrawn to be recycled at fixed industrial sites. Aluminum is most attractive for this application because of the large domestic industry expected in the 1980's. Battery performance is projected from reported cell data for a hardware designed for rapid addition of electrodes. The reaction product is processed in the battery to form a purified, dry powder of trihydrated alumina—a feedstock of the current aluminum industry. For a 30-kW peak battery weighing 220 to 250 kg, ranges of 500 to 750 km are estimated for a one-ton vehicle. Costs of recycled aluminum and air-cathode modules comprise 85 percent of the total cost (ca 5 cents/km) of battery ownership and operation. 7 figures, 5 tables.

50368 Lithium electric cell. Feuillade, G. (to Compagnie Generale d'Electricite). US Patent 4,086,402. 25 Apr 1978. Priority date 19 Mar 1976, France. 4p.

The invention relates to a lithium electric cell comprising, in a first embodiment, a lithium negative electrode and a positive electrode made in particular of copper sulfide. The electrolyte comprises a salt such as tetralkylammonium chloride having predominantly anionic conductivity. In a second embodiment, the cell comprises between the electrodes a separation membrane made of an anionic exchanger material such as quaternized polyvinylpyridine. The electrolyte of the cathode compartment is tetralkylammonium chloride; the electrolyte of the anode compartment, a salt such as lithium perchlorate having predominantly cationic conductivity. The invention is implemented in cells in thin layers.

50369 Alkali metal/niobium triselenide cell having a dioxolane-based electrolyte. Whittingham, M.S.; Newman, G.H. (to Exxon Research and Engineering Co.). US Patent 4,086,403. 25 Apr 1978. Filed date 26 Nov 1976. 4p.

An improved rechargeable, high-energy-density electrochemical cell comprises an anode having as its active material an alkali metal, a cathode having as its active material a transition metal trichalcogenide and a nonaqueous electrolyte containing at least one ionizable salt of the anode-active material dissolved in a dioxolane solvent. A specific example is an electrochemical cell with an anode-active material of lithium or alloys thereof, a cathode of niobium triselenide, and an electrolyte of lithium perchlorate dissolved in dioxolane. 1 table.

50370 Rechargeable battery. Izumi, K. (to Izumi Products Co.). US Patent 4,086,523. 25 Apr 1978. Filed date 17 Jan 1977. 6p.

A rechargeable battery includes a storage cell, a housing enclosing the storage cell, a rectifier in the housing, and a pair of output terminals exposed for delivering electrical energy from the storage cell. The battery is provided with a pair of prongs arranged for electrical connection to a female power supply receptacle. The prongs are pivotally mounted at opposite sides of one of the terminals to extend selectively in a first disposition straddling one end of the housing, and a second disposition projecting from that one end in parallel-spaced relationship to be received in the female power receptacle. The electrical circuit of the rechargeable battery includes a switch for electrically connecting the prongs to the rectifier and storage cell to permit recharging of the storage cell from the female power supply receptacle only when the prongs are disposed in the extended disposition. The prongs may be biased both to the retracted disposition and the extended disposition, and at least one of the contacts may be a spring contact for effectively maintaining electrical connection between the prongs and the charging circuitry. One of the contacts of the switches may be defined by a portion of the prongs. 6 figures.

50371 Modern lead—acid battery designs for aircraft. Bagshaw, N.E.; Bromelow, K.P.; Kirkpatrick, J. (Chloride Industrial Batteries Ltd., Manchester, Eng.). pp 25-34 of Power sources 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

24-V, 34-Ah and 24-V, 18-Ah batteries were designed to meet the requirements of modern aircraft. The batteries have a good performance at high discharge rates combined with reliability in service. A completely new ventilation system was designed which enables gases to be piped outside the aircraft and ensures that all live connections are remote from the gases. The batteries are assembled in flame-retardant, acid-resistant fiberglass containers and covers. The batteries are completely aerobatic and comply with all the electrical and environmental conditions of the latest British Standard for aircraft batteries. 4 figures, 2 tables.

50372 Rechargeable lead dioxide system with sulphuric acid electrolyte and soluble negatives. Faber, P. (RWE Electrochemie, Karlstein, Ger.). pp 45-57 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

Only a few electronegative materials can be used as negative electrodes with PbO_2 positives, in sulfuric acid. Compared with zinc, cadmium shows much better self-corrosion behavior, but the solubility of cadmium sulfate has a limiting effect on weight and volume. The system $PbO_2/H_2SO_4/Cd$ was developed as a working reversible battery. Discharge curves for the C1 and C10 rates are given, and the variation of capacity with discharge current is shown. The Peukert relation I/sub E//sup n/t/sub E/ = constant does not apply. The electrolyte density changes in a complex way with changes in state of charge. Difficulties arise from dendrite build up during charging. A 40-Ah cell has given 200 cycles.

50373 Low maintenance battery systems for aircraft applications. Bishop, W.S.; Lander, J.J. (Air Force Aero-Propulsion Lab., Wright-Patterson Air Force Base, OH). pp 103-110 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

Vented, sintered-plate nickel—cadmium batteries have found, as a result of their good low-temperature and high-discharge-rate characteristics, increased use aboard U.S. military aircraft since their introduction during the 1950s. The deficiencies that have emerged during the use of these batteries have been high operating cost and frequent cases of overheated batteries. These deficiencies have led to the investigation of several concepts to reduce their impact. Among these concepts are improved separators, modification of electrode active material loading, battery monitoring systems, and integral battery/charger systems. These concepts are described herein.

50374 Ni—H_2 battery flight experiment. Dunlop, J.D.; van Ommering, G.; Earl, M.W. (COMSAT Labs., Clarksburg, MD). pp 231-247 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

INTELSAT and Naval Research Laboratory plan a flight demonstration of a nickel—hydrogen battery on the Navigation Technology Satellite 2 to be launched late in 1976. COMSAT Laboratories is providing the cells and Naval Research Laboratory is responsible for the battery design, fabrication, and spacecraft integration. Both the cells and the battery are described here. The salient feature of the cell design is the use of electrochemically impregnated positive nickel hydroxide electrodes. Performance data show that these electrodes are superior to the conventional chemically impregnated electrodes.

50375 Nickel oxide—hydrogen cells. Kordesch, K.V.; Cieszewski, S.J. (Union Carbide Corp., Cleveland). pp 249-258 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

The use of special hydrogen electrodes (originally developed for alkaline fuel cells) in conjunction with the application of design concepts used in making commercial batteries makes possible the construction of metal oxide—hydrogen cells in the D size (RM-20) configuration. Such cells show excellent cycle life as well as high current charge and discharge performances, and can be safely overcharged and reversed. The capacity-per-weight compares favorably with equal size nickel—cadmium and lead—acid cells, but the capacity-per-volume is lower. By means of construction measures and the proper choice of the H_2 electrode, the self-discharge of Ni—H_2 cells during shelf storage was reduced without changing the cycling characteristics.

50376 High-energy long-life zinc battery for electric vehicles. von Krusenstierna, O. (AGA Innovation Centre, Taeby, Sweden). pp 303-319 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th inter-

national symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

A secondary nickel—zinc traction battery for electric vehicles was developed with energy densities at the 2 h rate of 45 to 65 Wh/kg, depending on the choice of nickel cathodes. A lifetime of more than 1000 cycles was experimentally obtained with a 6-cell, 2-kW battery, and the zinc dendrite problem was solved to such an extent that the nickel cathodes seem to be the life-determining part of the cell. Traction cells in sizes up to 350 Ah were developed and tested successfully, and energy densities up to 80 Wh/kg seem possible in a well-optimized cell construction. Electric vehicles with this type of high-energy, long-life zinc battery will have a range of at least double what can be reached with a modern lead—acid traction battery.

50377 Ni—Zn rechargeable cell of the fixed electrolyte type. Tajima, S.; Nakamura, M.; Mori, T. (Tokyo Metropolitan Univ.). pp 321-333 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

A Ni—Zn rechargeable cell with a soluble Zn anode and KOH electrolyte fixed by a synthetic sponge was constructed and the typical cell characteristics were investigated. The cycle life of the cell was tested, the cause of the capacity decrease with increase in the number of cycles was considered, and remedies are suggested.

50378 Problems in the use of high-energy-density aluminium—air batteries for traction. Despic, A.R.; Drazic, D.M.; Zecevic, S.K.; Grozdic, T.D. (Univ. of Belgrade). pp 361-368 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The advantages of using Al in a battery are reviewed. However, its reactivity with water is a problem. Attempts to alloy Al to reduce its chemical activity while retaining its electrochemical activity are described. Small additions (<0.2%) of In, Ga, or Tl were beneficial. The alloys were tested in an "exchangeable-plate" battery. The air electrodes were of the active carbon metal grid—plastic backing type. Initial results were typical of the single-electrode values. Improved performance was obtained by using a porous plastic diaphragm between the metal and air electrodes. The calculated energy density of the experimental cell was 80 Wh/kg. On the basis of these results, a 30-kWh traction battery of 10 kW nominal power was conceived, with an energy density of 200 Wh/kg. 4 figures. (RWR)

50379 Rechargeable quinone battery for load levelling. Binder, H.; Knoedler, R.; Koehling, A.; Sandstede, G.; Walter, G. (Battelle-Inst. e.V., Frankfurt am Main). pp 643-653 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

A rechargeable battery system with solid quinones as active masses, which are insoluble in acids, is described. Oxanthranol (anthrahydroquinone) is used for the negative plate; and chloranil (tetrachloro-p-benzoquinone), for the positive plate. Overvoltage is small in the charge and discharge modes even at high current densities. More than 90% of the quinones can be utilized at a discharge rate of 10 h. For a laboratory model with a storage capacity of about 20 mAh/cm^2 a current yield of about 98% and an energy yield of about 90% were measured at a discharge rate of about 10 h. Lifetime does not appear to be limited by deep discharges or quick recharges. After more than 100 cycles electrodes with chloranil showed no loss in capacity.

50380 Performance characteristics of lithium—aluminium/iron sulfide cells. Walsh, W.J.; Shimotake, H. (Argonne National Lab., IL). pp 725-733 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The development and testing of engineering-scale lithium—aluminum/iron sulfide cells at Argonne National Laboratory are summarized. The program objective is to develop high-performance, low-cost batteries suitable for use in electric vehicles and electricity generating systems. Specific energies of 100 to 150 Wh/kg and peak specific powers of 130 to 145 W/kg were demonstrated. Lifetimes gradually increased from a few hundred hours to several thousand hours, and the development of an industrial manufacturing capability has begun. Recent development of an uncharged Li—Al/FeS/sub x/ cell has solved problems related to outgassing and changes in shape of the electrodes. 7 figures.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 50391, 50399, 50403

50381 Behaviour of lead—acid batteries under pulsed discharge conditions. Jayne, M.G. (Gwent Coll. of Higher Education, Newport, Wales). pp 35-44 of Power sources 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The behavior of typical lead—acid traction batteries under continuous discharge, interrupted discharge, and pulsed discharge conditions is reported in detail, and it is concluded that the lead—acid cell under pulsed discharge conditions exhibits a marked variation in behavior from that which occurs under steady discharge conditions. The difference is probably attributable to the recovery phenomenon which appears to occur during each cyclic interruption of the battery current.

50382 Cyclic voltammetry of lead and a lead—antimony battery grid alloy in aqueous sulphuric acid at 25° to -40°C. Chang, T.G. (Cominco Ltd., Mississauga, Ont.); Wright, M.M.; Valeriote, E.M.L. pp 69-89 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The cyclic voltammetry of lead and antimonial lead was studied in 1.25 sp gr H_2SO_4, at 25°C to -40°C, at sweep rates of 0.42 to 42 mV/s, between hydrogen and oxygen evolution and over narrower regions of potential. The latter, coupled with systematic variation of the positive or negative reversal potential, revealed peak shifting and hysteresis effects which give further insight into the nature of the reactions of the lead—acid battery. The significance of the results to the improvement of charge acceptance at low temperatures is discussed.

50383 Sealed nickel—cadmium and lead—acid batteries: comparison of functioning mechanisms. Atkin, J.; Bonnaterre, R.; Laurent, J.F. (Societe des Accumulateurs Fixes et de Traction, Romainville, France). pp 91-101 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The rotating ring-disc electrode technique was used to study the electro-reduction of disc-generated oxygen on a cadmium ring in KOH solutions and on a lead ring in H_2SO_4 solutions. Measurements of the reduction currents showed that these are a function of oxygen solubility. These currents are approximately five times greater in 5M H_2SO_4 than in 7M KOH. While cadmium is thermodynamically stable in alkaline solutions, lead is not stable in acid solutions; to minimize hydrogen evolution and positive grid corrosion, it is necessary in sealed lead—acid cells to use alloys having a high hydrogen overpotential. During overcharging oxygen reduction on the lead electrode lowers hydrogen evolution by a mechanism analogous to an anodic protection. The experimental results presented show that a sealed lead—acid cell must be conceived according to the classical rules used in sealed nickel—cadmium cells. 8 figures.

50384 Performance characterics of a new iron—nickel cell and battery for electric vehicles. Birge, J.D.; Brown, J.T.; Feduska, W.; Hardman, C.C.; Pollack, W.; Rosey, R.; Seidel, J. (Westinghouse Research and Development Center, Pittsburgh). pp 111-128 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international sympo-

sium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

A new iron—nickel battery was developed, primarily for propulsion power in vehicles. Prototype iron and nickel electrodes, iron—nickel cells, and batteries were bench evaluated. Also, prototype batteries were tested in three different types and weights of ground vehicle systems, both of the passenger and delivery van types. Field tests with an early-version battery demonstrated energy requirements to be 300 Wh/mile (187 Wh/km) at 20 to 30 mph (32.2 to 48.3 km/h) for a 2500-lb (1136-kg) Marketeer vehicle and 275/350 Wh/mile (170/218 Wh/km) at 60 mph (97 km/h) for a modified 2100-lb (954-kg) Lotus Europa passenger vehicle. More recently, a newer version of this battery operated from 150 to 400 Wh/mile (93 to 250 Wh/km) at 20 to 50 mph (32.2 to 80.5 km/h) in a 3300-lb (1500-kg) delivery van, in a simulated (hilly) postal delivery route in the Pittsburgh area.

50385 Ageing of the nickel—cadmium system. Bramham, R.W.; Doran, R.J.; Pomroy, S.E.A.; Thompson, J. (Royal Aircraft Establishment, Hampshire, Eng.). pp 129-159 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

The behavior of the nickel—cadmium system after extended storage in the discharged state was studied. In addition to investigating the characteristics of aged sintered-plate button cells over wide ranges of temperature and charge rate by use of constant current and constant voltage charging, both positive and negative electrodes were studied galvanostatically and potentiostatically and by scanning electron microscopy. Results indicate that charging efficiency losses after ageing are greater at the nickel electrode than at the cadmium electrode, and are interpreted in terms of structural changes at the former and crystal growth at the latter.

50386 Cause of "stepped" discharge curves in nickel—cadmium cells. Barnard, R.; Crickmore, G.T.; Lee, J.A.; Tye, F.L. (Ever Ready Company (Holdings) Ltd., London). pp 161-179 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

Formation of the alloy Ni_5Cd_{21} in the negative electrode of nickel—cadmium cells subjected to continuous charging at elevated temperatures (75°C) is shown to be the main cause of the "stepped" discharge curves. The alloy was characterized by independent electrochemical synthesis and x-ray diffraction. The potential lowering during discharge is related to a lowering in free energy during alloy formation. Pure Ni_5Cd_{21} samples were found to have open circuit potentials about 100 mV lower than cadmium. Alloy formation is strongly dependent on temperature and time. Finely divided Ni metal produced by co-reduction of added $Ni(OH)_2$ is found to form the alloy more readily than the sinter alone.

50387 Electrode kinetic study of carbon electrodes in polysulphide melts. Brennan, M.P.J. (Chloride Silent Power Ltd., Cheshire, Eng.). pp 693-710 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

The electrode reactions taking place within the sulfur electrode of a sodium—sulfur cell were studied at simple carbon electrodes by standard electrochemical techniques. Mechanisms are proposed for the anodic and cathodic reactions, and substantiating evidence for these mechanisms was obtained from a microscopic study of thin-layer cells. 11 figures, 4 tables.

50388 Performance of different types of sodium—sulfur cells. Kleinschmager, H.; Haar, W.; Weddigen, G.; Fischer, W. (Brown, Boveri and Company AG, Heidelberg). pp 711-723 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

Various types of sodium—sulfur cells were compared with respect to rechargeability, cell resistance at different states of charge, and lifetime. The cells were varied as follows. Standard cells were homogeneously packed with graphite felt in the cathode compartment and filled with pure sulfur. A second type of cell contained felt-free holes in the cathode compartment. A third type contained selenium and boron as additives. The rechargeability is higher and the cell resistance is lower for the last two types of cell. If silicon is excluded from the cathode compartment, only a negligible decrease of cell performance with cycling is observed. 4 figures, 1 table.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 50374, 50382, 50385, 50387, 50708

50389 Battery charger. Casagrande, S. (to Controlled Systems (Windsor) Ltd.). US Patent 4,087,733. 2 May 1978. Priority date 29 Jul 1975, Canada. 6p.

A battery charger in which full-wave rectified current is supplied to a battery through a silicon-controlled rectifier (SCR) is described. By controlling the gating of the SCR the average charging current is controlled. An oscillator circuit formed by a unijunction transistor with a timing capacitor in its emitter circuit provides the necessary gating pulses. The charging rate of the capacitor is controlled to alter the period during which the SCR is conductive. This control of the charging rate is provided by a circuit responsive to battery voltage and by a circuit responsive to charging current. A portion of the battery-voltage-responsive circuit acts to short-circuit the capacitor to stop charging in the event that the battery is connected with reverse polarity. A high-charging-rate mode is controlled by a timer circuit which overrides the normal voltage and current control circuits. 2 figures.

50390 Power sources with silver electrodes. Andreeva, G.P.; Vorob'eva, G.B.; Legkii, I.N.; Nikol'skii, V.A. *J. Appl. Chem. USSR (Engl. Transl.);* **50**: No. 10, 2170-2174(Oct 1977).

Translated from Zh. Prikl. Khim.; 50: No. 10, 2266-2270(Oct 1977).

Degradation of organic battery separators through reaction with the active mass of silver oxide electrodes led to an investigation of inorganic separators. It was shown in studies with inorganic separators deposited electrophoretically directly on to electrodes that separators made of calcium sulfate, calcium hydroxide, magnesium oxide, and zirconium oxide possess high chemical stability in the alkaline electrolyte, are practically inert with respect to the electrochemical properties of the silver and cadmium electrodes, and have a highly developed structure that serves to inhibit the diffusion of silver ions and organic molecules. The small additional resistance created by the inorganic separator has an effect on the discharge voltage only at low temperature and high current density. It was found that the shelf life of charged silver—cadmium power sources with the inorganic separators studied is 1.5 to 2 times as long as that of power sources without such separators. The long charge retention was attributed to lower reduction rates of the silver oxides. Separators of zirconium oxide have optimum properties for use in silver—cadmium batteries. 2 figures, 1 table. (RWR)

50391 Effect of grid conductivity on the performance of tall lead-acid cells. Bagshaw, N.E.; Bromelow, K.P.; Eaton, J. (Chloride Industrial Batteries Ltd., Manchester, Eng.). pp 1-14 of Power sources 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

Tests on 3-electrode cells showed that an additional conductor to the bottom of a tall, flat, pasted positive electrode increased the capacity by 8 and 12% at the 5-h and ½-h rates, respectively. An extra conductor to the bottom of the negative electrode increased the capacity by 12% at the high rate. Tall multi-electrode cells containing high-conductivity grids gave 18% more energy than standard cells at the ½-h discharge rate and 43% more energy when discharged at constant high power. Increased grid conductivity had a more marked effect in the case of the positive than the negative electrode.

50392 Potential distribution in the lead—acid battery grid. Tiedemann, W. (Globe-Union Inc., Milwaukee); Newman, J.; DeSua, F. pp 15-23 of Power sources 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

Equations were developed to describe the potential distribution over an unpasted battery grid operating under a uniform current density. Satisfactory agreement was obtained between computer and experimental results. Computer results are also presented which show the effects of lead redistribution and fracture of grid elements on the change in the grid potential.

50393 Kinetic investigations at a PbO_2 ring-disc electrode. Pohl, J.P.; Rickert, H. (Universitaet Dortmund, Ger.). pp 59-68 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The lead dioxide electrode is at the same time a lead and an oxygen electrode. At least two partial currents have to be considered, that of lead ions and that of oxygen ions. With a PbO_2 ring-disc electrode it was shown that different partial currents appear at the lead dioxide electrode, especially for transient and cut-out processes. From this it was proved that with cathodic and anodic polarization of a PbO_2 electrode the partial current of the lead ions has at first the opposite direction from the one it has in the stationary state. After the end of the cathodic and anodic current loading, plumbous ions continued to dissolve out of the PbO_2 or to deposit into the PbO_2. This is a very important indication that the stoichiometry of the lead dioxide was changed during the flow of current and was restored currentlessly after the end of the polarization back to the initial equilibrium value.

50394 Plastic bonded cadmium electrodes prepared by a rolling technique. Jindra, J. (Czechoslovak Academy of Sciences, Prague); Mrha, J.; Micka, K.; Zabransky, Z.; Braustein, B.; Malik, J.; Koudelka, V. pp 181-200 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

With the use of fibrous poly(tetrafluoroethylene) and a rolling technique it is possible to prepare cadmium electrodes which show the course of cycling in alkaline medium a fairly constant capacity and reproducible current—potential characteristics. In this respect tight packing of the electrodes appears more beneficial than loose; an addition of 2.5% poly(tetrafluoroethylene) is necessary to ensure that the active mass has the correct properties for it to be rolled, and 7 to 15% polyethylene ensures the mechanical strength and elasticity of the binding skeleton. Electrodes bonded with 10% poly(tetrafluoroethylene) were used also in vented Ni—Cd cells in combination with pocket-type nickel oxide electrodes.

50395 New processes for the incorporation of the active mass into sintered electrodes of the nickel—cadmium battery. Sathyanarayana, S. (Indian Inst. of Science, Bangalore, India); Gopikanth, M.L.; Sridharan, L.N. pp 201-213 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The positive (nickel hydroxide) electrode in Ni/Fe, Ni/Cd, Ni/Zn, and Ni/H_2 battery systems is fabricated in a variety of forms such as the pocket plate, the pressed plate, and the sintered plate. The negative electrode of a Ni/Cd battery is also generally made with a sintered nickel plaque. An important disadvantage in using sintered Ni electrodes is that a rather large amount of Ni is employed in inactive form. Three new processes were evolved that may be used to minimize the quantity of nickel contained in the pore walls of sintered electrodes without any loss of structural integrity. The new processes also permit an acceleration of active mass incorporation into the electrodes. The processes are electroprecipitation with periodic reverse current, anodic oxidation in the presence of chloride ions, and controlled pore expansion by anodic dissolution. After an explanation of each process, experimental details are given and the results are discussed. 7 figures. (RWR)

50396 New possibilities in the technology of electrodes for alkaline accumulators. Cenek, M.; Kouril, O.; Sandera, J.; Touskova, A.; Calabek, M. (Brno Technical Univ.). pp 215-230 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

Results of technological experiments with plastic-bonded cadmium and zinc electrodes are presented. In comparison with pocket-type electrodes the results of measurements on cadmium electrodes confirm that service life, power, and output parameters at standard temperature are comparable, and at 253 K, even better. Plastic-bonded electrodes save weight, and it is believed that there will be a reduction in the labor required for bulk production. A plastic-bonded zinc electrode gives longer service life, shows no growth of dendrites, and provides high resistance against shape changes during cycling operation.

50397 Materials for carbon-based primary and secondary air electrodes. Appleby, A.J.; Crepy, G.; Feuillade, G. (Centre de Recherches de la C.G.E., Marcoussis, France). pp 549-568 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The object of this study was to produce a low-cost secondary air electrode of moderate performance for use in KOH electrolyte. Intrinsic activity and structural characteristics were measured as a function of type of treatment for a wide range of carbonaceous materials. Certain graphitized or partially graphitized carbons of moderate BET area were shown to have the required oxidation resistance, and lifetimes greater than 1000 2-h cycles at 100 A/m^2 (1.5 h charge, 0.5 h discharge) were demonstrated. Good activities and stabilities were also shown by certain polyphthalocyanines on low-surface-area graphite supports.

50398 Developments in ceramic to metal seals for sealed battery systems. Reed, L.; Anderson, N.; McRae, R. (ILC Technology Inc., Sunnyvale, CA). pp 607-626 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The design of ceramic-to-metal seals for terminal assemblies and the techniques utilized in making them are described. Among the reasons for using a ceramic-to-metal seal is its ability to withstand high pressures and, when suitable materials are used, electrochemical corrosion. An alumina—zirconium—nickel seal, developed for Ni—Cd and $Ni—H_2$ batteries, has been qualified for space applications. The same system (Al_2O_3—Zr—Ni), and others, have also been tested for application in the Li—FeS/sub x/ and Na—S cells. Simulated lifetimes of 4000 h were obtained in the Li system; satisfactory corrosion resistance was obtained on the Na side of the Na—S cell, but the sulfide side is still being researched. Passivation of the metal members or protective overcoatings hold the most promise.

50399 Study of the electrode interface formed between sodium metal and beta alumina solid electrolyte. Gibson, A. (Chloride Silent Power Ltd., Cheshire, Eng.). pp 673-692 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The interface between sodium and beta-alumina electrolyte was studied between 200°C and 400°C by examination of the contact angle of sodium on beta-alumina tubes. The contact resistance at the interface was determined in the same temperature range by calculating the difference between the 2-terminal dc resistance of the electrolyte between sodium electrodes and the bulk resistance of the electrolyte measured by a 4-terminal dc method. Wetting of beta-alumina does not occur at temperatures below 300°C, and a high contact resistance is observed. At 350°C the electrolyte is wetted and contact resistance is minimal.

50400 Electrode designs for high performance lithium—aluminum/iron sulfide cells. Gay, E.C.; Vissers, D.R.; Yao, N.P.; Martino, F.J.; Kaun, T.D.; Tomczuk, Z. (Argonne National Lab., IL). pp 735-749 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The development of charged and uncharged positive and negative electrodes for lithium—aluminum/iron sulfide (FeS_2 or FeS) cells is described. The cells are being developed for off-peak energy storage batteries in utility networks and batteries for electric vehicle propulsion. Electrode design parameters investigated were thickness, area, type of current collector, and volume fraction of electrolyte. Electrode fabrication methods studied included electrochemical formation, hot-pressing, and vibratory loading of active material into porous current collector structures. These studies led to significant progress in achieving the power density and capacity density required of cells for both applications. 5 figures, 5 tables.

50401 Lamellar compounds of graphite for the chlorine electrode in an Al-Cl_2 battery. Maximovitch, S.; Bronoel, G.; Nghia, N.T.; Sarradin, J. (Laboratoire d'Electrolyse du C.N.R.S., Bellevue, France). pp 751-757 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

The Al/Cl_2 system in a chloroaluminate electrolyte has a high energy density (1.350 Wh/kg) at relatively low temperature (the eutectic point of a NaCl (50%)—$AlCl_3$ (50%) mixture is near 110°C). Secondary chlorine electrodes consisting of insertion compounds of graphite were studied at different temperatures (110 to 170°C). The intercalate compounds are metallic chlorides and oxides ($FeCl_3$, $AlCl_3$, $HgCl_2$, $SbCl_5$, $MoCl_5$, WCl_6, $NiCl_2$, $CrCl_3$). The samples were submitted to charge—discharge cycles, and the materials were selected on the basis of mass capacity. 4 figures, 2 tables.

50402 Organic electrolyte cell. Gunther, R.G. (to Yardney International Corp., Los Angeles, Calif. (USA)). German(FRG) Patent 2,520,497/A/. 2 Oct 1975. 17p. (In German).

An invention is described to improve the operation of galvanic elements with organic electrolytes. The improvement consists in that one adds a non-ionic surfactant (or wetting agent) to the organic electrolyte in the order of magnitude of 0.01 to about 2 weight percent of the organic electrolyte. Alkyl aryl polyether, alkyl aryl polyethylene glycol ether and alkyl aryl polyether alcohols are given as examples of such surfactants. Sodium or lithium is preferably used as anode material and a carbon tetrafluoride as cathode material. Lithium perchlorate, for example, dissolved in propylene carbonate, is used as organic electrolyte. The lifetime of the cell is greatly increased by adding the surfactant. Discharge rate curves are given for a few selected examples.

APPLICATIONS

REFER ALSO TO CITATION(S) 50367, 50384, 50455, 50633

50403 Batteries for bulk energy storage on the U.K. electricity supply system. Hart, A.B.; Webb, A.H. (Central Electricity Research Labs., Surrey, Eng.). pp 627-641 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

A wide range of rechargeable electrochemical batteries is reviewed for possible bulk energy storage on the U.K. Electricity Supply System. The annual capital charges of the various batteries are estimated. It is shown that none of the present commercially available batteries can meet the break-even target of approximately 30 pounds/kW output per annum. Among the "advanced" systems sodium—sulfur and possibly lithium—chlorine and aluminum—chlorine show promise of costs below the target if the development problems can be inexpensively overcome. The iron—air, zinc—chlorine, and lithium—sulfur systems are estimated to cost slightly more than the target, but are being actively developed and costs might be reduced. Redox systems also look promising on cost grounds, but have a low volume energy density which presents some siting problems. 2 tables.

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 50410

50404 (CONF-780225—) **Egypt—United States cooperative energy assessment: report on preliminary discussions.** (Department of Energy, Washington, D.C. (USA). Developing Countries Energy Program). Apr 1978. 54p. Dep. NTIS, PC A04/MF A01.

From Egypt-US cooperative energy assessments conference on preliminary discussions; Cairo, Egypt (14 Feb 1978).

Egyptian and U.S. Government representatives met in Cairo during the period of February 14-22, 1978 to discuss a cooperative Egypt-U.S. assessment of the energy demand and supply options available to Egypt. This report summarizes those preliminary discussions. The discussions accomplished the following: the background and objectives of the U.S. initiative for a cooperative energy assessment with Egypt were explained; Egyptian electric energy activities and their priorities were presented; methods under consideration for the systematic identification and assessment of energy options available to Egypt were explained; the cooperation of Egyptian energy resource and planning organizations was assured; and arrangements to carry out the cooperative assessment were planned.

50405 (COO—2977-1) **NYIT Energy Advisory Service implementation plan.** Tenen, G.B. (New York Inst. of Tech., Old Westbury (USA). Center for Energy Policy and Research). 26 Aug 1976. Contract EY-76-S-02-2977. 63p. Dep. NTIS, MF A01.

Portions of document are illegible.

The philosophic basis and proposed implementation of an energy outreach program were set forth in a proposal of December 5, 1975 and in a revised proposal and budget of March 22, 1976, submitted after consultation with ERDA officials. The objectives and scope of work for the initial ten-month period presently contracted, and for the balance of the proposed two-year program, are summarized in the ERDA document "Project: Outreach Program for Energy Information Dissemination in Adjacent Areas of New York, New Jersey, and Connecticut". A copy is included at the end of this report. The implementation plan set forth here specifies the nature and the time schedule of the work to be accomplished throughout the tem-month and the two-year periods. In order to disseminate information to target audiences, the institute will utilize various energy technology channels of communications, including, the Energy Information Center; NYIT Energy Hot Line; Metropolitan Regional Council Television Seminars; Referral Services; press releases; technical assisance teams; newspaper question-and-answer columns; traveling displays; contests; conferences; radio spots; volunteers; and Center for Energy Policy and Research Periodical. All energy topics are included, but priority in the short term will be given to energy management programs for small commercial/industrial plants; residential building insulation and weatherization; solar hot water heating and solar space heating systems; and heat pumps. (MCW)

50406 (COO—2977-2) **NYIT Energy Information Center. A first report.** Magat, G. (New York Inst. of Tech., Old Westbury (USA). Center for Energy Policy and Research). 16 Aug 1976. Contract EY-76-S-02-2977. 13p. Dep. NTIS, PC A02/MF A01.

The Energy Information Center was created to serve (1) the research and information dissemination purposes of the Center for Energy Policy and Reearch, and (2) the information outreach programs of the Energy Advisory Service established by the Center. The Center is primarily concerned with (a) energy conservation, (b) alternative energy sources, (c) energy usage, and (d) energy policy, and insofar as they relate to these matters, it is concerned secondarily with fossil energy, nuclear energy, and international energy developments. Accordingly, the Energy Information Center acquires materials in such fields as engineering, economics, and the political, social, and behavioral sciences. In addition to serving the research and information dissemination needs of the Center for Energy Policy and Research, the Energy Information Center also supports the Center's Energy Advisory Service outreach program in which information and technical assistance in the use of energy conserving techniques and equipment is made available to industrial and commercial organizations, public officials, homeowners, and the general public throughout the New York New Jersey, and Connecticut area.

50407 International Energy Agency. Paris; Organization for Economic Co-Operation and Development (1977). 25p.

In the wake of the 1973/74 energy crisis, negotiations among some of the principal industrialized countries, led in November 1974 to an Agreement on an International Energy Program. This agreement is the outcome of a joint endeavor to strengthen cooperation on energy policy among Participating Countries. In order to administer the Agreement, the International Energy Agency (IEA) was established in Paris as an autonomous body within the Organization for Economic Co-operation and Development. Its institutional and organizational structure, aims, research programs on energy, relations with producer and other consumer countries, information system and emergency preparation program are described. (MCW)

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 50411, 50470, 50481, 50489, 50544, 51656

50408 (EPRI-EA—620(Vol.1)) **Energy and the economy. Final report.** Hogan, W.W. (Stanford Univ., Calif. (USA). Inst. for Energy Studies). Jan 1978. 40p. Dep. NTIS, PC A03/MF A01.

The Electric Power Research Institute created the energy Modeling Forum to improve the use and usefulness of energy models. This report presents the results of a comparison of six models of energy and the economy. The comparison illuminates the structure of the models and identifies the importance of a few key elements in determining the nature of the feedback from the energy sector to the remainder of the economy: the value share of energy, the potential for the substitution of capital and labor for energy, and the interaction between energy availability and capital formation. The strengths and weaknesses of the models in application to the study of energy and the economy are discussed, with emphasis on the contribution to improved communication between decision makers and energy modelers.

50409 **Energy analysis.** Thomas, J.A.G. (ed.). Boulder, CO; Westview Press Inc. (1977). 166p. $15.00.

A collated reprint of articles from the journals Energy Policy and Food Policy.

This collection of 14 reprinted journal articles is a record of research conducted in the UK, the USA, and the Federal Republic of Germany on energy analysis. The papers are: Energy costs: a review of methods, Peter F. Chapman; The energy cost of fuels, Peter F. Chapman, Gerald Leach and M. Slesser; The energy costs of materials, Peter F. Chapman; An international comparison of polymers and their alternatives, R. Stephen Berry, Thomas V. Long II and Hiro Makino; Energy and food production, Gerald Leach; The energy cost of goods and services—an input-output analysis for the USA, 1963, David J. Wright; The energy cost of goods and services—an input-output analysis for the USA, 1963 and 1967, Clark W. Bullard III and Robert A. Herendeen; The energy cost of goods and services—an input-output analysis for the Federal Republic of Germany, 1967, Richard V. Denton; Energy analysis of nuclear power stations, Peter F. Chapman; Nuclear power and oil imports—a look at the energy balance, J. H. Hollomon, B. Raz and R. Treitel; Energy analysis of a power generating system, K. M. Hill, F. J. Walford and R. S. Atherton; The economics of energy analysis, Michael Webb and David Pearce; The economics of energy analysis reconsidered, Michael Common; and Net energy analysis—is it any use, Gerald Leach.

50410 **Methodology for estimating consumption of primary fuels by area sources at the county level.** Chng, K.M. (Bolt Beranek and Newman Inc., Cambridge, MA); Mann, C.O. pp 137-146 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

County-based fuel-use estimates find increasing applications in such areas as generating an emission inventory for various pollutants; disaggregating these emissions into sub-county levels for state air quality maintenance planning; examining the impact of various fuel curtailment strategies; providing a basis for making fuel allocation policies; and, in long term maintenance of air quality through land-use control. This paper describes the methodology that is used to compile fuel consumption data for inclusion in the National Emission Data System (NEDS) area source file. While the original studies for the National Air Data Branch (NADB) were more encompassing in scope and in the number of categories examined, the contents of this paper is limited only to examining a subset of this large combination of user-fuel type categories. The subset can be delineated into two broad groups as: stationary source fuel consumption (residual, distillate; commercial/institutional, residual; and industrial, natural gas, bituminous and anthracite coal, and LPG) and motor vehicle fuel consumption (light-duty vehicles gasoline; heavy-duty vehicles, diesel; off highway vehicles and railroad).

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 49704, 50408, 50424, 50430, 50431, 50432, 50433, 50434, 50441, 50443, 50444, 50445, 50446, 50447, 50462, 50470, 50471, 50472, 50473, 50485, 50506, 50512

50411 (IIASA-RR—77-22) **Macrodynamics of technological change: market penetration by new technologies.** Peterka, V. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Nov 1977. 134p. Dep. NTIS (US Sales Only), PC A07/MF A01.

The report deals with mathematical modeling of technological substitution processes. Its main objectives are: on the basis of plain and well-understood assumptions, to (1) derive mathematical models of market penetration for any number of competing technologies, (2) explain existing empirical models and rules, (3) develop computational tools for analysis and forecasting of technological substitutions, and (4) apply the models to substitution of primary energy sources in world energy consumption. The approach adopted is based on the long-term balance of capital flows governing production using one of several competing technologies. The main assumption made is that a viable technology, when established, has to live and grow on its own account, i.e. that the mean value of the external capital flow is equal to zero. In this way a set of differential equations is obtained by which the multivariate competition is governed. Using market shares instead of the absolute production of particular technologies makes it possible to eliminate the market price and decomposes the description and forecasting of the substitution process into the evolution of market shares and the growth of the total production of the given commodity. This is, perhaps, the main trick in the development of the model. Only the dynamics of market shares is followed in detail.

50412 (LBL—7808) **Urbanism and energy in developing regions.** Meier, R.L.; Berman, S.; Dowell, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Mar 1978. Contract W-7405-ENG-48. 100p. Dep. NTIS, PC A05/MF A01.

The pace of urbanization must continue, because in most parts of the world the surplus population in the countryside has nowhere else to go. The world is about 40% urban now and apparently headed for the 80 to 90% share of the total population presently exhibited by the developed countries. Thus, the 1.6 billion urban dwellers in 1978 would become about 3 billion in 1995--if major catastrophes can be avoided. Feasibility assessments for Sao Paulo-Rio de Janeiro, Calcutta, Cairo-Alexandria, Mexico City, and Seoul are presented in the appendices. This analysis-from-a-distance is insufficient to judge how much extra installed electrical generating capacity is required before 1995, the added refining capability for liquid fuels, or the uses for new LNG and coal imports due to be arranged. It is evident that energy (and perhaps also water in most regions) planning is the major determinant of the manner in which these urban areas will adapt to the extraordinary pressures for new settlement. The current round of planning in such metropolitan areas has been addressed to solving traffic-congestion problems, and reorganizing land use in central districts, as the most-pressing issues. Since energy sources and distribution systems now affect the largest and most crucial investments in urban growth it is to be expected that future metropolitan planning may concentrate upon energy efficiency. Energy supplies must be planned to meet requirements set by locally dominant values regarding human services and the environment.

50413 (NP—23243) **Houston and energy: where are we going.** Coomer, J.; Howell, J.R.; Kaplan, C.; Schiflett, M.; Thomas, R.W.; Warkov, S. (Houston Univ., Tex. (USA). Energy Inst.). 1977. 22p. Univ. of Houston, TX.

Draft, prepared for Energy and you conference held at University of Houston, Nov. 12 and 13, 1977.

This publication establishes some basic data on Houston and energy, and then examines the possible impacts of energy shortages and rising energy prices on Houston's future economy, government, lifestyle, and general growth. The future is divided into 3 time periods; the near term (the next 5 to 10 years); the mid term (up to the year 2000); and far term (post-2000 era) and the consequences of energy supplies in each time period are examined. Actions on the part of Houston to forestall the problems named are summarized. These briefly stated include development of an infrastructure to handle coal; planning for the impact of possible shifts of growth patterns; and plans to encourage mass transit. (MCW)

50414 (JPRS—71224) **Methods of calculating cost of industrial products.** 2 Jun 1978. Translated from a Chinese report. 219p. NTIS.

This report contains information compiled by the Anhwei Provincial School of Finance and Economics, published by the China Financial and Economic Publishing House, introduces several methods for calculating the cost of products commonly used by industrial enterprises in China. The cost of products is determined by 3 factors: (1) object of the calculation; (2) period for the calculation of the cost of products; and (3) whether production expenses are to be appropriated between finished and unfinished products.

50415 **Energy, economic growth, and human welfare.** Schurr, S.H. (Resources for the Future, Washington, DC). *EPRI J.;* 3: No. 4, 14-18(May 1978).

The relationships between economic growth, energy growth, and human welfare are analyzed to see which policy approaches are the most appropriate in light of current controversies over energy-

supply projections and environmental protection. The debate over linking gross national product with human welfare is examined in terms of minimizing conflict through economic growth; it is concluded that worldwide economic growth is needed to deal with the needs of developing countries, although serious planning is needed to develop growth strategies that will preserve the quality of life. The connection between energy demand growth and economic growth is found to span three periods, with only the most recent period showing a parallel growth rate and with a relatively small decline in the ratio during periods of drastic changes in energy output. The effects of greater energy efficiency and supply constraints are concluded to be areas of preconception rather than fact and should not be used to form pessimistic policies based on adversary approaches.

50416 Gross national product function and the derived demand for imports and supply of exports. Kohli, U.R. *Can. J. Econ.;* **11**: No. 2, 167-182(May 1978).

The substitution possibilities between Canadian imports, exports, and domestic inputs or outputs are modeled. Import demand and export supply functions are derived from a representation of the technology that is similar to Samuelson's GNP function and are estimated simultaneously with the demand and supply functions of the domestic factors or goods. Exports, investment goods, and consumption goods are found to be substitutes for each other in production. Furthermore, exports and investment goods are import-intensive, and the results indicate that a devaluation of the Canadian dollar would raise the return to capital and lower the return to labour.

50417 Weighing conflicting concerns in frontier development. Paproski, D.M. *Nat. Resour. Forum;* **2**: No. 3, 257-270(Apr 1978).

It is no longer perceived that development proposals will automatically assure a net improvement in social well-being. This is particularly so in the case of frontier development. In these areas, information on economic and engineering costs and social and environmental effects is scarce, and projected outcomes from such a base are therefore questionable. The views of indigenous populations living in frontier areas can provide a valuable insight into possible effects of development, as shown in the decision-making process regarding natural gas pipeline construction in the Canadian northwest. Reference to this case suggests that it may be possible to design this process to permit economic development and to assure that environmental, social, and local economic objectives are met.

50418 1977 trade summary by area: developing nations led way to modest U.S. export gains. Barker, K.; Sobotta, T.; Tucker, J. (Dept. of Commerce, Washington, DC). *Commer. Am.;* **3**: No. 6, 2-4(13 Mar 1978).

An article on overall trade developments appeared in the Feb. 13 issue.

The pattern of U.S. trade with each of the major areas of the world in 1977 generally paralleled the movement in overall U.S. foreign trade. Export increases to most areas were relatively modest while imports from nearly all regions climbed briskly. Reflecting the persistent sluggishness of economic activity in most industrial countries last year, exports to the developed nations, which as a group account for more than 60% of U.S. shipments abroad, increased at a relatively slow rate of 5%. In fact, sales to these countries in the second half of the year were below the level recorded in the first. Exports to the developing countries picked up momentum slightly, compared to the rate of growth in 1976, but the rise was nevertheless only a modest 7%. Deliveries to both the oil-exporting nations and the others in this group rose substantially in value in the final six months of the year after declining in the January-June 1977 period. Imports from the developed countries, as a group, expanded by 17% in value last year. Although these purchases climbed briskly throughout most of the year, the overall rate of increase was somewhat slower than in 1976. Imports from the developing nations expanded by 28%, also a slower rate than in the preceding year. These receipts declined in the second half, primarily because of a downturn in arrivals of coffee and petroleum. Specific commodities traded with many nations are discussed in the article.

50419 Gas and electricity prices. The Government's reply to the fourth report from the Select Committee on Nationalised Industries, Session 1975—76, H.C. 353. London; Her Majesty's Stationery Office (1977). 13p. 35 p net.

The government considers that gas and electricity prices should be at economic levels that reflect the cost of supply, encourage the best use of national energy resources, and avoid subsidies from public expenditure. This has meant substantial increases in recent years following the price restraint introduced by the previous administration. The government has been concerned that these increases should not result in hardship to poorer consumers, and those less able to look after themselves. It has therefore ensured that increases in pensions and other social security benefits in the last two years have more than kept pace with increases in the Retail Price Index which includes increases in fuel prices. It has also improved the extra heating allowances which are available where necessary to those receiving Supplementary Benefit and are for use with any fuel. The Government has been providing extra help with electricity bills, in the form of discounts for recipients of Supplementary Benefit (SB) or Family Income Supplement (FIS). The gas and electricity industries, in consultation with the government, have published a Code of Practice on Payment of Domestic Electricity and Gas Bills presented at the end of this report.

50420 Part II. Petroleum and natural gas economics. pp 79-140 of Economics of natural and environmental resources. New York; Gordon and Breach Science Publishers Inc. (1977).

Part II contains chapters 5-7, with specific citations as follows: (5) J. McKie and S. McDonald, "Petroleum Conservation in Theory and Practice," Quarterly Journal of Economics, 76: 98-121 (February 1962); (6) P. Davidson, "Public Policy Problems of the Domestic Crude Oil Industry," American Economic Review, 53: 85-108 (March 1963); and (7) R. Kuller and R. Cummings, "An Economic Model of Production and Investment for Petroleum Reservoirs," American Economic Review, 64: 66-79 (March 1974).

50421 Farmer adjustments to higher energy prices: the case of pump irrigators. Skold, M.D. Washington, DC; Dept. of Agriculture (1977). 17p.

Higher energy prices cause farmers using pump irrigation systems to consider several adjustment possibilities. These farmers are not generally able to pass higher energy input cost on to consumers, so higher energy prices will necessarily result in changes in the production process within the firm. These adjustment possibilities include shifting to more energy-efficient crops, reducing the amount of energy used per acre of a given crop, substituting other inputs for energy inputs, or selecting more energy-efficient farming practices and irrigation distribution systems. The potential for each of these possibilities is limited. Increased energy prices pose special challenges for the pump irrigators.

50422 Energy tariffs and the poor. London; Department of Energy (1976). 31p.

The note examines ways of (a) adjusting gas and electricity tariffs with the aim of helping poorer consumers and (b) introducing free fuel allowances for restricted classes of consumer. Whether the industries' present tariff structures are based on sound principles are examined, and various possible general tariff adjustments, concessionary tariffs, and special fuel allowances are illustrated and discussed.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 50420, 50429, 50430, 50443, 50444, 50445, 50446, 50447, 50480, 50524

50423 (NP—23262) Environmental/socioeconomic data sources. TAB A-1 supplement. Environmental planning bulletin 13, volume 1, October 1976. Kavaliunas, J. (Department of the Air Force, Washington, D.C. (USA). Environmental Planning Div.; Bureau of the Census, Washington, D.C. (USA). Center for Census Use Studies). Oct 1976. 170p. NTIS.

The first section of the report is concerned with demographic and economic information available from the Bureau of the Census; local planning agencies and chambers of commerce; other valuable local resources; and other federal data. The second section is concerned with defining the total region of influence and relevant jurisdictions; getting the basic census publications; and examples and exercises. The third section discusses where to find specifics needed in census publications. The fourth section gives a detailed description of federal data sources; methods for obtaining census publications; and guidelines to census bureau data including demographic, economic, housing, and government and public finance data. (HLW)

50424 Econometric analysis of environmental policy: estimation of a model of the Canadian pulp and paper industry. Muller, R.A. (McMaster Univ., Hamilton, Ont.). *Can. J. Econ.;* **11**: No. 2, 263-286(May 1978).

An econometric model of the Canadian pulp and paper industry, formulated specifically to simulate the effects of changes in production costs due to mandatory pollution controls, is specified and estimated. Differing structures are assumed for each of the newsprint, woodpulp export and other paper and board markets. Simulation and sensitivity tests are reported. The model consistently demonstrates low sensitivity to outside shocks, with less than unitary elasticities of major variables with respect to real income changes, unit factor requirement changes, and exchange rate variation. The expected costs of pollution control should not depress output by more than 2 percent.

50425 Manpower for environmental pollution control. Washington, DC; National Academy of Sciences (1977). 447p. $11.25.

The Committee for Study of Environmental Manpower reviewed the literature that has developed in the field of environmental manpower, a key element in successful prosecution of an effective national pollution-control program. This Committee was responsible for analyzing current and future scientific and technical manpower needs for such a program. In its study, the Committee considered the profile of personnel requirements in this field, estimates of personnel supply and demand, sources of personnel, and the ways in which individuals with scientific and technical competence are brought into the pollution-control work force. In addition, the Committee examined EPA responsibilities and programs for education and training of pollution abatement and control manpower. The committee concludes that a large supply or general shortage of pollution-control manpower is not now apparent or likely to develop in the near future. Additional conclusions are discussed. (MCW)

50426 Part VI. The environment. pp 348-506 of Economics of natural and environmental resources. New York; Gordon and Breach Science Publishers Inc. (1977).

Part VI contains chapters 21-28, with specific citations as follows: (21) R. Ayres and A. Kneese, "Production, Consumption, and Externalities," American Economic Review, 59: 282-297 (June 1969); (22) V. Smith, "Littering, Derelicts and the Pricing System," previously unpublished; (23) Published without the appendix in V. Smith, "Dynamics of Waste Accumulation--Disposal versus Recycling," Quarterly Journal of Economics, 86: 600-616 (November 1972); (24) E. Keeler, M. Spence and R. Zeckhauser, "The Optimal Control of Pollution," Journal of Economic Theory, 4: 19-34 (February 1972); (25) W. Brock, "A Polluted Golden Age," previously unpublished; (26) A. Fisher, J. Krutilla, and C. Cicchetti, "The Economics of Environmental Preservation--A Theoretical and Empirical Analysis," American Economic Review, 62: 605-619 (September 1972); (27) K. Arrow and A. Fisher, "Environmental Preservation, Uncertainty, and Irreversibility," Quarterly Journal of Economics, 88: 312-319 (May 1974); and (28) V. Smith, "Economics of Wilderness Resources," Intermountain Economic Review, 7: (Fall 1976).

50427 Environmental assessment and impact statement handbook. Cheremisinoff, P.N.; Morresi, A.C. Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1977). 445p. $29.50.

This new book provides a complete and practical discussion of the evaluation process from the standpoint of persons required to prepare an EIS. It gives information on ground rules, guidance, interpretation, procedure, problem scope, and format. The book gives information on the National Environmental Policy Act of 1969, preparing the statement, assessing and evaluating the EIS, methodology, air quality, water and water resources—including land, solid wastes, noise, economics, oil spills, nuclear power, radioactive waste treatment, petroleum refinery environmental assessment, and assessment of the rubber industry. The book's valuable appendixes contain: The National Environmental Policy Act of 1969—Council on Environmental Quality Guidelines; Preparation of Experimental Impact Statements—Environmental Protection Agency Final Regulations; and Preparation of Environmental Impact Statements—Environmental Protection Agency New Source NPDES Permits.

50428 Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976). 583p. (CONF-760411—). $22.00.

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

Since the 16th Annual Meeting in Boston, programs have been noteworthy for their orientation from principally aerospace environmental fields of interest to complementary blend encompassing earth environmental sciences and education, and since 1974, contamination control. From a total of 94 papers presented, 24 were selected for Energy Research abstracts; three papers had appeared previously.

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 50417, 50426, 50474, 50479

50429 (CONF-761258—) Transcript of the first public meeting on the Resource Conservation and Recovery Act of 1976. (Environmental Protection Agency, Washington, D.C. (USA)). 1976. 177p. U.S. Environmental Protection Agency, Washington, DC.

From 1. meeting on the resource conservation and recovery act; Washington, DC, USA (16 Dec 1976).

The Deputy Administrator of the Environmental Protection Agency, Joyhn Quarles, presented the opening remarks, stating mainly that the agency will attempt to formulate the policies that will guide the development of implementing the Resource Conservation and Recovery Act. Mr. Quarles answered questions from the members of the audience who represented all sectors of the economy. Then, Roger Strelow from the Air and Waste Management Division made some broad remarks involved in implementing the Resource Conservation and Recovery Act of 1976, and specifically its relationship to other legislative authorities. A senior officer in the agency (Jack Leshman) presented some specifics about the hazardous waste program. Then George Garland presented issues from the Act concerning land disposal. In the afternoon session Nick Humber addressed the area of resource recovery and economic incentives. Lanny Hickman, director of the management information staff, approached the state program development. Tom Williams presided over the discussion on training, public information, and public participation to close the meeting. (MCW)

50430 (FEA/G—77/101) Use of brackish ground water resources for regional energy center development, Tularosa Basin, New Mexico: preliminary evaluation. (Federal Energy Administration, Washington, D.C. (USA)). Mar 1977. 517p. Dep. NTIS, PC A22/MF A01.

New Mexico shares with most other Rocky Mountain and High Plains states prodigious energy resources essential for meeting future national and regional demands for energy. However, development of those resources will require use of water resources that are already over-appropriated in virtually every western state--water resources that often are equally necessary for balanced, indigenous economic growth. As a measure of the increasing demand on western water resources, the Western States Water Council estimates that by 1990 energy production in the region will require an increased annual commitment of approximately 2.3 to 3.1 million acre-ft of water. The purpose of this study is to contribute to the growing knowledge about the feasibility of energy centers, particularly in relation to utilization of hitherto unallocated and mainly unusable groundwater in the Western States. Specifically the suitability of the Tularosa Basin in south-central New Mexico as the site for a regional energy center is studied. The center is assumed to be primarily nuclear with varying potentials for fossil, solar, geothermal, and wind energy-generating facilities. The analysis also considers anticipated socio-economic and environmental impact on the region.

50431 Stability of non-replenishable resource prices. McRae, J.J. (Univ. of Guelph, Ont.). *Can. J. Econ.;* **11**: No. 2, 287-299(May 1978).

If resource owners are viewed as asset holders, price expectations may play a crucial role in intertemporal price behaviour. This paper, using both a nonparametric technique and the parametric methodology associated with Box and Jenkins, tests whether resource markets behave like perfect-asset markets. After removing the trend element, which captures the scarcity rent component of total cost rising at the rate of interest, real resource prices for five minerals over 53-year sample of monthly observations are shown to behave like a random walk. 23 references.

50432 Mining agreements in developing countries: issues of finance and taxation. Fritzsche, M.; Stockmayer, A. (Institut fuer Auslaendisches und Internationales Wirtschaftsrecht, Frankfurt am Main). *Nat. Resour. Forum;* **2**: No. 3, 215-227(Apr 1978).

This article continues a Forum series on recent trends in mining contracts between host countries and foreign investors begun in the April 1977 issue. Based on intensive research carried out for the preparation of a book on Mining Ventures in Developing Countries, published recently in the Federal Republic of Germany, the authors discuss sources of finance, institutions, exchange controls and special accounts, royalties, income taxation, and equity participation. They conclude that taxation is most likely to remain the principal source of income; equity participation should be evaluated carefully as it does not automatically guarantee maximum benefits. The combination of taxes and royalties provide a steady flow of income. An increase of the total tax burden beyond a certain percentage may be counterproductive for the host country, as it encourages the investor to look for less controllable means of shifting profits or discourages investment for exploration and development. 21 notes and refs.

50433 United Nations Panel on International Mining Finance. Zorn, S. *Nat. Resour. Forum;* **2**: No. 3, 291-299(Apr 1978).

Conference review.

Mining finance experts, meeting under the auspices of the United Nations Center for Natural Resources, Energy and Transport, agreed that sufficient capital could be provided to permit worldwide mineral demand to be satisfied, but that there was a danger that mining investment in developing countries would not keep pace with those nations' resource potential. A variety of suggestions were offered for improving the ability of developing countries to attract capital for mining.

50434 Optimal exhaustible resource depletion with endogenous technical change. Kamien, M.I.; Schwartz, N.L. (Northwestern Univ., Evanston, IL). *Rev. Econ. Stud.;* **45**: No. 139, 179-196(Feb 1978).

Technical advance is treated as endogenous and a cost factor in this analysis of an exhaustible resource using an optimal-growth model. Only drastic technical changes that alter the resource replenishability are considered. The results show that research and development (R and D) efforts rise until they are successful or until economic constraints cause them to decline. The temporal patterns are not altered when extraction costs are incorporated as the resource stock decreases. Possible extensions of the model include the effect the nature of the technological advance has on future economic growth and the variations in the costs and risks of developing alternative technologies. Another point of concern is the possibility that developing countries may lack the economic resources to develop exhaustible energy resources in time to benefit from them. The analysis can also be applied to the case of R and D projects undertaken for profit in a stationary environment. 11 references.

50435 Fuel and energy complex of the Soviet Union and its importance in world energy economy. Vol'fberg, D.B. (State Comm for Sci and Tech, USSR). *Teploenergetika (Moscow);* No. 11, 66-69(Nov 1977). (In Russian).

The rapid rate of development of the Soviet fuel and energy complex since 1929 is briefly surveyed and compared with the slower growth in the USA, Western Europe, and Japan. It is estimated that in 1975 the USSR produced 1587 million tons coal equivalent (Mtce) of energy and consumed 1412 Mtce, while the USA produced 2081 Mtce and consumed 2450 Mtce, Western Europe produced 658 Mtce and consumed 1550 Mtce, and Japan produced 37 Mtce and consumed 420 Mtce. In 1976, the USSR produced 711.5 million tons of coal (479 Mtce), i.e., 18.8% of world output. The Soviet output of electric power amounted to 1111 TWh, i.e., over 16% of world output. The power plants of the USSR produced 950 million Gcal of thermal energy, covering 2/5 of total requirements of heat energy in the country. The total installed capacity of electric power plants in the world amounted to 1.6-1.7 TW at the beginning of 1977, of which 72% were thermal power plants, 22% hydroelectric power plants and 6% nuclear power plants. The installed capacity in the USSR equalled 229 GW, i.e., 13.5-14.2% of world installed capacity.

50436 United Nations mineral exploration activities: 1960—1976. Carman, J.S. *Nat. Resour. Forum;* **2**: No. 4, 317-336(Jul 1977).

The United Nations Development Program plays an important role in strengthening the economies of developing countries through mineral exploration projects, training in geosciences, and institution building. This review demonstrates the effectiveness of such activities, both in terms of the economic value of mineral discoveries, and the less-tangible, long-term contribution through development of infrastructure and skills introduction of modern technology, and building up a body of reliable information as a base for future planning of mineral-resources development.

50437 Co-operation between CMEA-member countries over mineral resources. Markov, I.A.; Skliarov, V. (United Nations, Geneva). *Nat. Resour. Forum;* **2**: No. 4, 337-345(Jul 1977).

The Council for Mutual Economic Assistance is providing a base for raising its members' reserves and production of fuels and mineral raw materials through co-operation. The authors outline the framework for this cooperation, highlight the special role of the resources of the USSR, and provide illustrations of the cooperative projects under implementation or planning. 10 references.

50438 Frontier areas, resources, and developing nations: the case of Guatemala. McIntosh, T.L.; Fitzsimmons, A.K. (Univ. of Kentucky, Lexington). *Nat. Resour. Forum;* **2**: No. 4, 347-357(Jul 1977).

The conscientious and planned integration of frontier areas into the national economy can at least partially alleviate both environmental and economic problems that are common to many developing countries. Full development of the agricultural potential of frontier areas can lessen the environmental deterioration often found in traditionally settled regions. Exploitation of mineral resources, particularly energy resources, can lessen economic burdens associated with increased costs of imported energy. The authors examine how recent international developments have spurred the government of Guatemala to undertake measures designed to develop a previously underutilized region. The short-term negative consequences of increased costs for imported grains and petroleum may well have a positive result in the long term, insofar as they lead to more balanced and rational use of land and resources.

50439 Africa takes a look at its energy problems and projects. Arungu Olende, S. (United Nations, Geneva). *Nat. Resour. Forum;* **2**: No. 4, 361-367(Jul 1977).

An intergovernmental meeting in 1963, organized by the U.N. Economic Commission for Africa and held in Addis Ababa, had concentrated on electricity development in the Continent. A second such meeting, held in Accra in November 1976 had wider objectives. These included appraisal of the present energy situation and future prospects, an analysis of trends in energy resources, supplies and marketing, cooperation among Member States, information exchange, training, and the coordination of energy policies. The meeting considered papers which dealt with a wide range of subjects in conventional energy sources (coal, petroleum, natural gas, electricity), non-conventional sources (solar, nuclear and geothermal energy) and non-commercial sources such as wood and wood products. There were presentations covering cooperation, training of the skilled manpower needed in the field of energy in the region, and the environmental impact of energy development and utilization in Africa. Recommendations and general observations made at the meeting are summarized.

50440 Challenge of Africa's water development. Krishnamurthy, K.V. (United Nations, Geneva). *Nat. Resour. Forum;* **2**: No. 4, 369-375(Jul 1977).

Africa is endowed with some of the world's most abundant water resources and some of the most impressive water-project engineering. Yet the distress and devastation caused by prolonged drought in the Sahel and several other countries, the acute problem caused by the lack of drinking water supply in several urban as well as rural communities, as well as for livestock; the near total dependence of African agriculture on the vagaries of rainfall; and the vulnerability of the economics of many countries of the Continent to the caprices of the forces of nature--all these underline the enormity of the tasks to be undertaken in the future, notwithstanding significant past achievements in the field of water-resources development. The need for water in all parts of Africa--be it for agriculture or industry, for food, fodder or fibre--points out that there should be no complacency. Water development should be regarded as one of the key elements needed to transform the present and bring a new Africa into being. The role of water in Africa's social and economic development, its potential for development, and the challenges are discussed. Lessons learned from the African experience are told. (MCW)

50441 Investment requirements in the non-fuel mineral sector in the developing countries. Takeuchi, K.; Thiebach, G.E.; Hilmy, J. *Nat. Resour. Forum;* **1**: No. 3, 263-275(Apr 1977).

Concern over the financial requirements for the long-term expansion of the world nonfuel minerals industry has led to growing interest in estimates of the magnitude of the requirements. The authors focus on the requirements in the developing countries for nine major minerals and deal with the most important among these, copper, in an appendix.

50442 Unterrichtung durch die Bundesregierung. Faktenbericht 1977 zum Bundesbericht Forschung. (Information through the Federal government. Facts report 1977 to the Federal report research). Bonn-Bad Godesberg, Germany, F.R.; Heger (1977). 279p. (In German).

The following are included: 1) Development of the resources: financing of R and D, carrying out R and D, overall budget in international comparison, and patent and licence balance. 2) Development of the main points of research promotion, including securing energy and raw material supply. 3) Institutes promoting research and research facilities, including the tasks and structure of KfK mbH and KFA Juelich. 4) Statistics on research.

50443 Economics of natural and environmental resources. Smith, V.L. (ed.). New York; Gordon and Breach Science Publishers Inc. (1977). 515p. $29.50.

The book has its origin in the growing interest in the economic, social, and ecological problems peculiar to natural and environmental resources. A separate abstract was prepared for each of the 6 parts of the book (a total of 28 papers) under subjects of: Theory of Exhaustible Resources; Petroleum and Natural Gas Economics; Biological Resource Economics; Water Resources Economics; General Theory of Production from Natural Resources; and the Environment. (MCW)

50444 Part I. Theory of exhaustible resources. pp 1-78 of Economics of natural and environmental resources. New York; Gordon and Breach Science Publishers Inc. (1977).

Part I contains chapters 1-4 with specific citations as follows: (1) R. Cummings, "Some Extensions of the Economic Theory of Exhaustible Resources," Western Economic Journal, 7: 201-210 (September 1969); (2) N. Vousden, "The Theory of Exhaustible Resource Use--A Basic Model," a revision and extension of "Basic Theoretical Issues of Resource Depletion," Journal of Economic Theory, 6: 126-143 (April 1973); (3) V. Smith, "An Optimistic Theory of Exhaustible Resources," Journal of Economic Theory, 9: 384-396 (December 1974); and (4) P. Dasgupta and G. Heal, "The Optimal Depletion of Exhaustible Resources," Review of Economic Studies Symposium, 3-28 (1974).

50445 Part III. Biological resource economics. pp 141-269 of Economics of natural and environmental resources. New York; Gordon and Breach Science Publishers Inc. (1977).

Part III contains chapters 8-15, with specific citations as follows: (8) H. Wan, "A Generalized Wicksellian Capital Model--An Application to Forestry," Economic Papers, Economic Institute, Academia Sinica, Taipei, 1-13 (1965); (9) A. Scott, "Optimal Utilization and Control of Fisheries," in Turvey and J. Wiseman, eds., The Economics of Fisheries, Round Table sponsored by International Economic Association, 7, Rome, FAO, 1957; (10) R. Turvey, "Optimization in Fishery Regulation," American Economic Review, 54: 64-76 (March 1964); (11) J. Boyd, "Optimization in Fishery Regulation--Comment," American Economic Review, 56: 511-517 (June 1966); (12) V. Smith, "General Equilibrium with a Replenishable Natural Resource," Review of Economic Studies Symposium, 105-115 (1974); (13) J. Crutchfield and A. Zellner, "Mathematical Formulations," Appendix 1, pp. 112-117 in "Economic Aspects of the Pacific Halibut Fishery," Fisheries Industrial Research I, Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C.; (14) C. Plourde, "Exploitation of Common-Property Replenishable Natural Resources," Western Economic Journal, 9: 256-266 (Sept. 1971); and (15) V. Smith, "The Primitive Hunter Culture, Pleistocene Extinction, and the Rise of Agriculture," Journal of Political Economy, 83: 727-755 (August 1975).

50446 Part IV. Water resource economics. pp 271-307 of Economics of natural and environmental resources. New York; Gordon and Breach Science Publishers Inc. (1977).

Part IV contains chapters 16-18, with specific citations as follows: (16) O. Burt, "Optimal Resource Use Over Time With an Application to Ground Water," Management Science, 11: 80-93 (September 1964); (17) O. Burt, "Temporal Allocation of Ground Water," Water Resources Research, 3: 45-56 (1st Quarter 1967); and (18) G. Brown and C. McGuire, "A Socially Optimal Pricing Policy for a Public Water Agency," Water Resources Research, 3: 33-43 (1st Quarter 1967).

50447 Part V. General theory of production from natural resources. pp 309-346 of Economics of natural and environmental resources. New York; Gordon and Breach Science Publishers Inc. (1977).

Part V contains chapters 19 and 20, with specific citations as follows: (19) V. Smith, "Economics of Production from Natural Resources," American Economic Review, 58: 409-431 (June 1968); and (20) O. Burt and R. Cummings, "Production and Investment in Natural Resource Industries," American Economic Review, 60: 576-590 (September 1970).

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 50434, 50442

50448 'Energy Research and Technology Program 1977/1980' of the Federal Department of Research and Technology. Schilling, H.D. *Glueckauf:* **113**: No. 18, 918-920(Sep 1977). (In German).

The Federal cabinet, assisted by the special committee 'Energy research and technology', established by the Federal Ministry for Research and Technology (BMFT), has adopted on the 27th April 1977 the programme 'Energy research and energy technologies 1977 to 1980'. For the first time, the programme incorporates all R+D activities important for the FRG's future energy supply in one overall concept, which makes the programme much more than just a continuation of the BMFT's former basic energy research programme. The article presents a) the focal points of the programme and the distribution of funds, and b) the main R+D activities.

50449 Towards an international strategy for energy research and development. Report by the International Energy Agency Steering Group on Energy Research and Development Strategy. Paris; Organization for Economic Co-Operation and Development (1977). 33p.

This report presents preliminary information and viewpoints, based upon a systematic approach, which could contribute to the definition of an international strategy for energy research and development among the Member countries of the International Energy Agency. The work reported herein represents a first phase effort, performed between May 1976 and February 1977, to scope the problem, carry out initial analyses, and suggest approaches to strategy development. Two systems analysis teams, working in parallel, were established at Brookhaven National Laboratory in the US and Kernforschungsanlage, Julich, Germany. Subjects discussed are: energy projections, a world view of the oil problem, future natural gas availability, the urgency of the problem, objectives for cooperative energy research, national energy objectives, possible elements of energy research, a possible strategy statement, support objectives, approaches to implementation, and technology characterization. (MCW)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 49609, 49618, 49619, 49620, 49664, 50156, 50347, 51631

50450 Understanding public perspectives on nuclear energy. Melber, B.D.; Rankin, W.L. (Battelle Human Affairs Research Centers, Seattle). *Trans. Am. Nucl. Soc.;* **28**: 319(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50451 Less-developed countries have a huge equity in nuclear power. Olds, F.C. *Power Eng.;* **82**: No. 3, 62-64(Mar 1978).

Three-quarters of the world's people live in less-developed countries (LDCs). Few of these are energy self-sufficient, and their dependence on imported oil grows more risky as burgeoning world oil consumption seems likely to reach a practical ceiling of production long before demand is satisfied. Hence, LDCs push their nuclear power programs, and hope for strong nuclear programs in the industrialized world to ease the demand for oil. Standing against the LDCs are the international intervenors and the nuclear slowdown policy of the United States.

50452 Sources of natural uranium supply for the Federal Republic. Klein, F. (Urangesellschaft m.b.H. und Co. K.G., Frankfurt am Main (Germany, F.R.)). *Atomwirtsch., Atomtech.;* **22**: No. 12, 648-650(Dec 1977). (In German).

The Federal Republic must almost exclusively rely on imported uranium to fuel its nuclear power plants, because deposits worth mining in the country cannot make significant contributions. The uranium companies established in 1967-1968 upon the initiative of the Federal Government, i.e., Uranerzbergbau of Bonn and Urangesellschaft of Frankfurt, have set themselves the task of supplying the Federal Republic with uranium. On a long term basis they want to satisfy some 60% of the German uranium requirement by direct interest in the production in various countries. In the medium and long term the Federal Republic will be responsible for 7% or 8% of the whole uranium requirement in the Western world, which is now estimated to amount to 80,000 to 100,000 t/a of natural uranium. The main countries of origin of the natural uranium supplied to the Federal Republic have so far been South Africa (including Namibia), Canada, France (including Gaboon and Niger), and the United States.

50453 Development of nuclear law 1974-1976. Breuer, R. *Neue Jurist. Wochenschr.;* **30**: No. 25, 1121-1129(Jun 1977). (In German).

The years 1974-1976 saw a lively development of nuclear law. The scene of this development was legislation as much as jurisdiction. The results are several acts amending the Atomic Energy Act, the new Radiation Protection Ordinance and some contemplative knowledge concerning the Nuclear Installations Ordinance pursuant to section 7 ff of the Atomic Energy Act.

50454 Begruendungen der Bundesregierung und des Bundesrates zu der Verordnung ueber den Schutz vor Schaeden durch ionisierende Strahlen (Strahlenschutzverordnung - StrlSchV -) vom 13. Oktober 1976 (BGBI. I Seite 2905). (Statement of reasons of the Federal government and the Bundesrat concerning the Ordinance on the protection against hazards through ionizing radiation (Radiation Protection Ordinance - StrlSchV -) dated 13th October 1976 (BGBI. I page 2905)). Frankfurt, Germany, F.R.; Verlags- und Wirtschaftsgesellschaft der Elektrizitaetswerke (1977). 55p. (In German).

In the text at hand, the statement of reasons of the Federal Council recommendations has been integrated into the statement of reasons in connection with the Federal Government's draft; thus a better understanding of the final ordinance text is achieved, and not only for the practioner. The background information in particular is very well explained.

TRANSPORT AND STORAGE

50455 (MTR—7592) **Lead-acid battery: an evaluation of commercialization strategies.** Davis, F.; Kuehnel, R.; Price, J.; Smith, G. (Mitre Corp., McLean, Va. (USA). METREK Div.). Nov 1977. Contract EC-77-C-01-5025. 268p. Dep. NTIS, PC A12/MF A01.

The purpose of this study is to determine if a significant market exists for lead—acid battery energy storage for electric utility peaking applications in the near term and to explore govern-

ment actions which could lead to a self-sustaining manufacturing industry directed toward such a market. The study does not address or evaluate issues associated with the development and implementation of a lead—acid battery demonstration. A review of existing literature and interviews with selected electric utilities are used to identify key parameters for market acceptance. Analytical techniques are developed to quantify these parameters and estimates of regional and national market size are made. Possible government actions are identified and qualitative criteria and measurements of cost effectiveness are developed. 30 figures, 40 tables.

50456 Energy storage technology. Fowler, J.M. *Aware;* No. 93, 11-15(Jun 1978).

Energy fact sheet.

With the depletion of natural gas and oil, large sources of energy will be needed. At present, the only candidates are solar energy, fusion energy or the fission-powered, breeder reactor. Storage is crucial—for solar energy because it is erratic, and for the others because they produce electricity that must be either used or stored as soon as it is generated. This Fact Sheet discusses the advantages that improved means of energy storage will bring. Various new storage technologies briefly discussed include a mechanical form (flywheels, pumped storage, compressed air); thermal form (solar collectors, heat pumps, off-peak storage frozen water reservoirs); and chemical form (batteries, fuel cells, magnetic storage, hydrogen). Storage technologies seem to promise more energy per dollar than those techniques that depend on exotic extraction or conversion methods. (MCW)

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 50185, 50467, 50615

50457 (CONF-780109—6) **Integrating technologies to produce energy conservation.** Holtz, R.E.; Marciniak, T.J. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 19p. Dep. NTIS, MF A01.

From Technology for energy conservation; Albuquerque, NM, USA (23 Jan 1978).

Portions of document are illegible.

Urban energy systems are essentially designed to meet the electrical, heating, cooling, and miscellaneous energy demands of the community they serve. This paper briefly reviews each of the more prominent of the past, present, and perhaps the future technologies. The systems are discussed in the order of the time frame of their commercial availability. Current technologies available for use in an urban system are: diesel engines, gas and steam turbines, combined cycle plants, electrical generation, central chillers, boilers, heat pumps, thermal storage, and solid waste incineration. Technologies expected to be available between now and 1985 are fuel cells, closed cycle gas turbines, Organic Rankine Cycle Engines, ACES, electric compressed air storage, solid waste pyrolysis, methane production, solar thermal, and coal gasification and liquefaction. Advance technologies cited are: advanced Rankine cycle, Minto wheel, Stirling engines, electrochemical storage, advanced fuel cells, and solar photovoltaics. The paper continues with an analysis of a fuel cell based system, a heat pump centered system, and a Diesel engine based system. The addition of a pyrolysis unit which employs the refuse from the site, with the Diesel engine based system, is also examined. The use of integrated systems is contingent upon many factors including energy savings, capital, and fuel costs, refuse disposal costs, system reliability and maintainability, reliability of fuel source, and certainty of the estimated energy demand in the community. (MCW)

50458 Results and tasks of development of heat-and-power plants and centralized heat-supply systems in the USSR. Belinskii, S.Ya.; Gromov, N.K. *Teploenergetika (Moscow);* No. 11, 72-74(Nov 1977). (In Russian).

The history of the development of district heating in the USSR is outlined, and the main problems of a further development of centralized heat-supply systems in the USSR are analyzed. In 1976, the capacity of district heating turbines amounted to 61.7 MW which equalled 36.5% of the total capacity of all thermal power plants in the USSR. Industry received centralized about 50% of this heat supply, and residential and public buildings in cities about 30%. Problems of corrosion of city hot water pipelines are stressed.

50459 News from heat supply undertakings. General report of district heating supply, 1976. *Fernwaerme Int.;* 6: No. 5, 241-251(Oct 1977). (In German).

The report gives a statistical overview of the development of district heating in the financial year 1976 in West Germany. The tables give information on the connected amounts and the heat outputs of the district heat supply undertakings and of the individual German 'Laender'. The quantities of heat and power produced from heating power stations and heating stations, climatic data and other characteristics which are typical of district heating supplies, are given numerically.

CONSERVATION

REFER ALSO TO CITATION(S) 50405, 50406, 50457, 50485, 50502, 50520, 50549, 50615, 50619

50460 (EMD—78-15) **Improvements needed in Department of Defense energy conservation investment program.** (General Accounting Office, Washington, D.C. (USA)). 18 Jan 1978. 22p. U.S. General Accounting Office, Washington, DC.

The Energy Conservation Investment Program (ECIP) was established in fiscal year 1976 as part of the military construction program. The program objective is to conserve energy at Department of Defense facilities by modifying energy-intensive systems and design deficiencies through self-amortizing retrofit projects. The types of projects to be included ranged from storm windows and insulation improvements to more advanced projects, such as heat-recovery wheels and energy-monitoring systems. The General Accounting office made a limited review of the program to determine its scope and structure, evaluate its overall management, and test its implementation. To test the program adequacy, 20 projects at 7 installations were reviewed. Recommendations are summarized.

50461 (FEA/D—76/469) **Consumers' attitudes, knowledge, and behavior regarding energy conservation.** (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Conservation and Environment). Dec 1976. 132p. Dep. NTIS, PC A07/MF A01.

The study summarizes information obtained from interviews conducted by telephone from ORC's WATS facility in Princeton, New Jersey. The information on the extent on which American consumers are conserving energy and their awareness of the attitudes towards conserving energy in their daily lives will aid the FEA to help plan and evaluate its energy conservation policies and programs. Survey questions dealt with subjects in 7 chapters: Private Individual's Willingness to Make Energy-Saving Efforts and their Perception of the Likelihood of Others Doing the Same; Public Knowledge, Attitudes, and Behavior Relating to Natural Gas Issues; Driving and Energy Conservation; Energy Saving Behavior Around the Home; Parents' Perceptions of their Children's Sources of Energy Information and Energy-Related Activities; Understanding of the Energy Situation and Evaluations of Alternative Actions. (MCW)

50462 (FEA/D—77/125) **Lender impacts upon energy conservation in buildings. Development and assessment of alternative government actions.** (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Conservation and Environment). Feb 1977. Contract EM-76-C-01-8619. 272p. Dep. NTIS, PC A12/MF A01.

The purpose of this investigation is four-fold: (1) identify facets of the real-estate loan-underwriting process that inhibit or promote the financing of energy-conserving devices and techniques in buildings; (2) delineate government actions that would encourage private lenders to finance energy-conserving devices and techniques; (3) estimate the financial institutions' probability of voluntary commitment to each of these government actions; and (4) estimate the impact of each government action on future real-estate-loan originations. The study clearly demonstrated the ease with which lender-oriented programs can be developed to which lenders will commit themselves and still achieve rather impressive improvements in the energy efficiency of buildings.

50463 (FEA/D—77-190) **Energy-efficiency improvement targets: chemicals and allied products.** (Battelle Columbus Labs., Ohio (USA)). 1977. Contract EM-76-C-01-8625. 52p. Dep. NTIS, PC A04/MF A01.

This volume represents the results of continuing work by Battelle in an effort to refine the data and analyses presented in the July 1, 1976, document and appendices thereto. Additional data and analyses are included for three important 4-digit SIC (product) classes: SIC 2822, Synthetic Rubber; SIC 2823, Cellulosic Man-Made Fibers; and SIC 2824, Synthetic Organic Fibers, ex Cellulosic. Projections are made for 1980 energy consumption. The revisions show a net target, including offset, at 10.7% for SIC 2822. For SIC 2823, the net energy efficiency goal is 19.8% and for SIC 2824, it is estimated companies should be able to reduce energy consumption in existing plants by 15% and in new plants by 30% over the 1972 energy consumption rate. (MCW)

50464 (FEA/D—77/250) **Energy-efficiency improvement targets: stone, clay, and glass products (SIC 32).** (Federal Energy Administration, Washington, D.C. (USA)). Mar 1977. Contract EM-76-C-01-8626. 43p. Dep. NTIS, PC A03/MF A01.

Following public hearings on December 9, 1976, and review of the written comments submitted to FEA, the final target for "Stone, Clay, and Glass Products" (Standard Industrial Classification 32) was developed and is described in this notice. It is intended to provide the basis for conservation activities undertaken in furtherance of the industrial energy-conservation program. The SIC 32 target is expressed as the percentage reduction in energy consumed per unit of output from the base year (1972) to the target year (1980). The reduction in energy was estimated for each of the 27 SIC 32 components. The procedure used in aggregating these component energy-efficiency improvements into an energy-efficiency improvement target for the entire stone, clay, and glass industry comprised in essence weighting the contribution of each component in terms of its relative total energy consumption. The draft target for energy efficiency improvement in SIC 32 which was determined to be technically and economically feasible was 17 percent, the percent reduction in energy consumed per unit of industrial output.

50465 (FEA/D—77/253) **Energy-efficiency improvement targets: primary metal industry (SIC 33).** (Federal Energy Administration, Washington, D.C. (USA)). Mar 1977. 36p. Dep. NTIS, PC A03/MF A01.

Following public hearings on December 9, 1976, and review of the written comments which were submitted to FEA, the final targets for "Primary Metal Industries" (Standard Industrial Classification 33) were developed and are described in this report. This report is primarily for the steel, aluminum, iron foundries, or copper components. These four components represent 12 of the 26 four-digit components comprising SIC 33. In sum though, based on technological feasibility and economic practicability, it is judged that SIC 33 could lower its 1980 energy consumption 13.8% per unit of output over the 1972 base case year.

50466 (NP—23127) **Potential for energy conservation: substitution for scarce fuels.** (Office of Emergency Preparedness, Washington, D.C. (USA)). Jan 1973. 109p. GPO $1.25.

This study on the conservation of the scarce energy fuels (oil and gas) through substitution of more abundant domestic fuels (coal) follows a previous study, The Potential for Energy Conservation. Because of the time period covered (1973-1985), consideration is not given to such alternative approaches as accelerated development of nuclear power, geothermal power, and solar power, which may ultimately substitute for part of the estimated future consumption of oil and gas. Projections of the rate of nuclear power availability have already slipped compared to earlier estimates and might slip still further. This study considers the potential for coal substitution in the case of slippage of nuclear power availability as well as in the case in which current estimates are realized. A third case which is worthy of examination is not considered in this study. That case is the accelerated availability of nuclear power and the costs and means of achieving such a goal. Such a development would serve the same national interest objectives as substitution of coal for scarcer fossil fuels. Between now and 1985, any decrease in energy consumption by energy conservation and any increased consumption of coal through substitution will result in reduced requirements for imports of Eastern Hemisphere oil (and to a lesser extent liquid natural gas). Hence, energy conservation and substitution serve as important preparedness measures to lessen hazards to national security, to broaden the freedom of action of U.S. foreign policy, and to help the balance of payments and other aspects of economic policy.

50467 **Dip in the energy store.** Dawes, J. *New Sci.;* **75**: No. 1067, 520-522(1 Sep 1977).

By the 21st century, when the world could face a real energy crisis as oil supplies dwindle, the swimming pool could be an essential part of the self-supporting, energy-conserving household rather than the luxury it is today. As the costs of heat-recovery systems fall and prime energy costs rise, the use of the swimming pool becomes more attractive. A pool is a superb catchment of water—and potential heat—which is usually allowed to go to waste. Developments in improved construction of swimming pools and lessons learned from operation of public baths are discussed. Installation of devices to recover heat before it is wasted and installation of others to transfer heat to places where it is needed are economical, and ozonation, replacing chlorination, makes recovery and re-use all the easier, according to the author. He also states that the swimming-pool environment is the perfect place for heat wheels, heat pumps, heat pipes, heat exchangers, and solar heaters. (MCW)

50468 **Energy conservation act and its significance for energy policies.** Krink, G. *HLH, Z. Heiz., Lueftung, Klim., Haustech.;* **28**: No. 4, 132-134(1977). (In German).

From Northern German technical meeting 1976 on 'Water heating in building construction'; Bremen, Germany, F.R. (9 Nov 1976).

Primary energy consumption in the FRG from 1963 until the first half of 1976 is reviewed. Parallels between energy consumption and economic growth are shown. Regulations going beyond the targets of the energy conservation act, concerning investment grants for energy-saving components and thermal insulation at a later stage are discussed. Problems resulting from different interests of tenants and landlords as regards construction costs and running costs are analyzed. Possible energy conservation in old buildings.

50469 **Mitteilung der Kommission an den Rat ueber Energieeinsparungen durch Modernisierung von Altbauten -Drucksache 8/660 - Beschlussempfehlung und Bericht des Ausschusses fuer Wirtschaft (9. Ausschuss) zu der Unterrichtung durch die Bundesregierung. (Notice of the Commission to the Council on energy conservation by modernizing old houses - printed matter 8/660 - Final recommendation and report of the Committee on Economy (9th Committee) concerning the information by the Federal Government).** Bonn-Bad Godesberg, Germany, F.R.; Heger (1977). 3p. (In German).

The Committee on Economy supports in principle the suggestions of the Commission of the European Communities, to reduce energy consumption in space heating by modernizing old houses. The committee is of the opinion, however, that the submitted proposal would lead to a community instrument in energy policies that would be too state-controlled; in Southern Italy, for example, thermal insulation measures would be of very little significance. The programme planned by the Federal Government with 4.35 billion DM in funds complies in the main with the proposal of the E.C. Commission. The Committee on Economy therefore recommends that the Bundestag to take note of the E.C. Commission's suggestion, yet at the same time to express the aforementioned misgivings.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 50439, 50451, 50489, 50507, 50508, 50544

50470 (EPRI-EA—700(Vol.1)) **Effects of risk on prices and quantities. Volume 1. Summary and policy implications of energy supplies. Final report.** Gilbert, R.J.; Stiglitz, J.E. (Microeconomic Associates, Berkeley, Calif. (USA)). May 1978. 57p. Dep. NTIS, PC A04/MF A01.

This volume is an executive summary of the major findings of the study. The research develops methodology for measuring the impact of risk and uncertainty on the supply functions for energy, develops techniques for assessing the value of information, and assesses alternative approaches to reducing risk and mitigating its effects. The research is directed toward issues of a conceptual nature and makes use of mathematical modeling, optimization techniques, and Bayesian statistics. The study develops models that should be useful for empirical work; however, no econometric modeling is included. The kinds of uncertainty and the associated economic issues on which the research focused included: geological uncertainty, demand uncertainty, uncertainty about the arrival time of new technology, uncertainty about the costs and availability of fuels and other factors, and the uncertainty surrounding policy actions of government agencies and regulatory bodies. While objectives of the research were mainly methodological, the decision maker will find explanations of economic institutions that provide a better understanding of the risk-bearing mechanisms of our economy; while he will not find a table of quantitative answers to questions of risk, he will find principles that can serve as a guide to more rational decision making under uncertainty. Also, new economical institutions that could aid in mitigation of uncertainty or in sharing risks involved in supplying energy to the American economy are described.

50471 (EPRI-EA—700(Vol.2)) **Effects of risk on prices and quantities of energy supplies. Volume 2. Overview of the economic theory of uncertainty and its implications for energy supply. Final report.** Gilbert, R.J.; Stiglitz, J.E. (Microeconomic Associates, Berkeley, Calif. (USA)). May 1978. 129p. Dep. NTIS, PC A07/MF A01.

This volume presents a synthesis of developments in the economic theory of uncertainty and a discussion of the implications of the theory for energy supply. Chapter 1 is an overview of the economics of uncertainty with precise definitions of basic concepts such as the meaning of risk, risk aversion, and insurance. Several propositions concerning the efficient spreading of risk and the possible mechanisms for risk-bearing are described. There is also a discussion of the efficiency with which the market provides insurance and other mechanisms for absorbing risks. Detailed applications of the economics of uncertainty to particular areas of energy supply are described in Volume III, but several general applications are suggested in this volume. Chapter 2 examines the effects of uncertainty on decisions of firms and industrial market structure. The results of this analysis cast doubt on several propositions of classical microeconomics. For example, firms may not choose the production technique with minimum cost in the presence of risk. There are

many problems that require a wider analysis than a study of an industry in isolation. The desirability of an action taken in one sector of the economy may depend on the response of the rest of the economy. The study of these economic repercussions is the subject of general equilibrium analysis. Chapter 3 surveys the economic analysis of uncertainty within a general equilibrium framework. Chapter 4 is concerned with analyzing what is meant by information and its economic value. The determinants of the value of information are discussed, and a careful distinction is drawn between the value of information for private use and its value to society.

50472 (EPRI-EA—700(Vol.3)) **Effects of risk on prices and quantities of energy supplies. Volume 3. Surveys of the effects of risk on energy supply. Final report.** Gilbert, R.J.; Stiglitz, J.E. (Microeconomic Associates, Berkeley, Calif. (USA)). May 1978. 250p. Dep. NTIS, PC A11/MF A01.

This volume is a collection of surveys that describe the application of the economics of uncertainty to the analysis of risk in particular components of the market for energy supplies. The first survey deals with geological uncertainty—uncertainty in the total amount, location, and cost of resource deposits; it examines in some detail the distinction between the social and private value of exploration information. Two surveys deal with the extraction of an exhaustible resource under uncertainty: one is concerned with the effects of risk—in the size and timing of discoveries and in the introduction of substitute sources of supply—on the optimal rate of extraction in an idealized economy; the other examines the effects of risk on the rate of extraction for different structures of the market, e.g., competition versus monopoly. Two surveys are included on the economics of technical change with exhaustible resources: one is a macroeconomic analysis of the determinants of a research program; the other looks more carefully at the organization of research activity and the effects of market structure on the pace of research. An important source of market risk is uncertainty about future policy actions of the many government agencies affecting the energy industry: included is a survey of policy uncertainty, concentrating on the role of expectations in the formation of energy prices and the use of standards versus taxes as regulatory devices. Finally, there is a separate survey of resource allocation during periods of shortages and the benefit/cost tradeoffs associated with assured supplies.

50473 (EPRI-EA—700(Vol.4)) **Effects of risk on prices and quantities of energy supplies. Volume 4. Technical reports. Final report.** Gilbert, R.J.; Stiglitz, J.E. (Microeconomic Associates, Berkeley, Calif. (USA)). May 1978. 101p. Dep. NTIS, PC A06/MF A01.

This volume is a collection of technical reports written in the course of the research program. The technical reports describe new results in a particular area of research. Two of the reports deal with the theory of contracting for research and development, and address questions such as contractual incentives and the distribution of gains between the contractor and contractee. Another report addresses the economic incentives for vertical integration, i.e., the replacement of a market for an intermediate factor by an internal-transfer mechanism. The fourth report deals with the effect of potential competition on the profit-maximizing pricing policy of a resource monopolist. The fifth report examines the degree of flexibility in response to uncertain input prices afforded by the choice of production technology by firms, and the effects of this flexibility on the distribution of prices. The sixth and final report concerns the efficiency of the stock market as an institution for sharing the risk associated with the total supply of exhaustible resources.

50474 (JACKFAU—75-122-8) **National energy accounts: energy flows in the U.S., 1947—1972. Volume I (Part 2). Final report.** (Faucett (Jack) Associates, Inc., Chevy Chase, Md. (USA)). Nov 1975. 111p. Dep. NTIS, PC A06/MF A01.

This Volume I, Part 2 begins with Chapter V, Inventory Account. Chapters that follow are entitled: Relationship Between Energy Flow Accounts and National Economic Input-Output Accounts; Availability and Comparability of Subnational Data, 1971; Comparison of Bureau of Mines and National Energy Flow Accounts Consumption Data. Additional data are compiled in 8 appendices. The contents of Volumes II, III, and IV to follow this volume are indicated in the Table of Contents. (MCW)

50475 (NP—23263) **Energy futures Northwest. Northwest Energy Policy Project final report.** (Northwest Energy Policy Project, Portland, Oreg. (USA)). May 1978. 182p. Pacific Northwest Regional Commission, Vancouver, WA.

This summary presents highlights of the findings and conclusions of the Northwest Energy Policy Project. It identifies regional, state, and local policy options that might influence future patterns of energy production and energy consumption in the Northwest states of Idaho, Oregon, and Washington. The Project evaluates the social, environmental, and economic consequences of exercising the various state and local energy policy choices. Chapter 2 discusses the present energy picture in the Northwest, including patterns of consumption, energy supplies, trends, and environmental impacts. Chapter 3 presents forecasts of alternative futures for Northwest energy demand and supply, provides an analysis of some of the comparative risks of overforecasting and underforecasting, and outlines the underlying assumptions for each energy-growth scenario. Chapter 4 describes ways in which future Northwest energy demand may be modified, particularly in terms of conservation policies and measures, and the extent to which such measures are likely to be acceptable and successful. Chapter 5 discusses energy supply issues and the ways in which state and local policies might be used to affect future energy supplies. Chapter 6 analyzes the principal impacts of alternative regional energy policies including economic and environmental impacts, and discusses some of the consequences of short-run, intermediate-run and long-run imbalances between energy supply and demand and what can be done about them. Chapter 7 deals with institutional issues such as public participation, ratemaking and energy facilities siting. Chapter 8 recapitulates the policy challenges identified and Chapter 9 indicates the likely disposition and future availability of the models and computer programs used in NEPP's investigations, explains how elusive "best" energy policies are to identify and offers help for policymakers in resolving energy policy conflicts.

50476 (NTISUB/C/027—001) **Energy information: report to Congress. Quarterly report: first quarter 1977.** Pelto, C.R. (ed.). (Federal Energy Administration, Washington, D.C. (USA); National Energy Information Center, Washington, D.C. (USA)). 1977. 118p. (FEA/B—77/181). Dep. NTIS, PC A06/MF A01.

Data are compiled on energy sources in the United States for the First Quarter 1977. Gains in total resource developments are discussed. Data on production, consumption, stocks, imports, exports, transportation, and reserves of coal are summarized. Data on natural gas and NGL are provided followed by data on supply and demand, production, imports, exports, refinery activities, inventories, allocations, and reserves for petroleum. Information on the status of domestic nuclear power plants, operating plants, construction, capacity projections and requirements, supply of nuclear fuels materials, and policy decisions is included. Electricity consumption, imports and exports, production, primary energy consumed and stockpiled by power plants and power plant conversion efficiency are presented. Data on hydropower are tabulated. (MCW)

50477 **Demand for energy in Canadian manufacturing: prologue to an energy policy.** Denny, M. (Univ. of Toronto); May, J.D.; Pinto, C. *Can. J. Econ.;* **11**: No. 2, 300-313(May 1978).

Manufacturing industries consume a large share of total energy consumption in Canada. The demand for energy is estimated for the years 1949-70 using annual national data. A non-homothetic generalized Leontief cost function is used to generate demand equations for labour, capital, energy, and materials. The own-price elasticity of energy is small, but substantial substitution possibilities exist. Homotheticity is rejected, and the results are very sensitive to this assumption. Simulations are run to show that the effects of large energy price increases on costs are small. Since energy and capital are complements, the major consequence of an energy price increase is a decline in the quantity of energy and capital demanded.

50478 **Technical initiatives on early sufficiency in energy.** Teller, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Int. J. Energy Res.;* **2**: No. 1, 3-7(1978).

A case is presented for three different approaches to solving the shortage of oil in the United States of America; conservation, solar energy and nuclear energy. The politics involved in the three approaches are reviewed. It is felt that emotion is exerting undue influences on energy policy decisions. In particular there has been a great deal of agitation and public concern about the safety of nuclear reactors in spite of their perfect health and safety record. The questions of nuclear wastes disposal, nuclear proliferation, and nuclear fuel supplies are discussed.

50479 **Cooperation between member countries of CMEA in the field of energy.** Oborotov, A.G. (Counc for Mutual Econ Aid, USSR). *Teploenergetika (Moscow);* No. 11, 74-76(Nov 1977). (In Russian).

In 1976 the member countries of the Council of Mutual Economic Assistance produced 1317 Mt of coal, 540 Mt of oil, and 358 Gm^3 of natural gas, which corresponds respectively to 32, 19, and 27% of world output. The output of electric power amounted to 1485 TWh, which is about 21% of world output. The overall consumption of energy resources in the socialist community amounts to about a quarter of world consumption. By 1990 energy consumption in these countries (without USSR) will amount to about 1 gage for coal equivalent (Gtce). Plans for the construction of transmission lines linking members of CMEA, and of power plants in individual countries are outlined. In particular, plans and problems of nuclear power plant construction and cooperation in nuclear power engineering are discussed. Plans for the construction of new hydroelectric power plants on the Danube are mentioned.

50480 Future of the world energy system. Global energy scenarios: 1. Status quo. 2. Nuclear power utilization. 3. Equilibrium strategies. Voss, A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)); Niehaus, F. (International Atomic Energy Agency, Vienna (Austria)). *Umsch. Wiss. Tech.;* **77**: No. 19, 625-632(Oct 1977). (In German).

In scenarios with several options, the possible ways for future energy supply (up to 2100) are discussed. Especially the effects of the CO_2 emissions from combustion processes, mainly an increase of the average temperatures, set limits to the possible use of fossil fuels. A transition to the practially unlimited energy sources nuclear and solar energy thus enforced can make a sufficient energy supply possible in a stationary state expected for the second half of the next century. The CO_2 loads and the temperature changes associated with it can be held below a reasonable limit only in this scenario.

50481 LORENDAS: a computer based system for the modeling of long-range energy development and supplies. Rapoport, L.A.; Soyster, A.L. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *Nat. Resour. Forum;* **2**: No. 1, 19-36(Oct 1977).

This paper reviews a time-dynamic linear programming modeling system designed for quantitative analysis of worldwide energy resource development and processing activities over a 25-to-30 year time horizon. The model includes explicit representation of exploration and production operations for energy minerals, as well as of the downstream supply, conversion, and distribution of different energy forms, accounting for interfuel substitution. The uses of this model, which include forecasts of resource development, assessment of new technologies, and analysis of energy policies, are discussed. The paper outlines a series of smaller, national, or regional energy planning models which can be derived from the worldwide LORENDAS modeling structure and tailored to the needs of individual developing countries.

50482 Thoughts on future energy supply. Welbergen, J.C. (Deutsche Shell A.G., Hamburg (Germany, F.R.); Mineraloelwirtschaftsverband e.V., Hamburg (Germany, F.R.)). *Oel;* **15**: No. 8, 212-216(Aug 1977). (In German).

Starting from an analysis of the available primary energy carriers, an attempt is made to analyze the FRG's energy supply up to the year 2000. Internationally as well as internally, the development of energy supply depends in particular on the following factors: 1) the extent of economic growth, 2) policies of OPEC countries as far as quantities are concerned, 3) type and implementation possibilities of governmental measures concerning energy policies, 4) additional supply of conventional energy carriers, 5) development of nuclear energy, 6) attitude of the consumers.

50483 Long-range energy perspective. Styrikovich, M.A. *Nat. Resour. Forum;* **1**: No. 3, 251-261(Apr 1977).

The author reviews general questions affecting energy projections and goes on to examine reserve forecasts for each type of energy. The last part of the paper considers consumption forecasts and makes an assessment of the likely situation in the year 2000.

50484 Gemeindliche Gebietsreform und regionale Energieversorgung. Zu den Grenzen gemeindlicher Betaetigungsfreiheit auf dem Gebiet der leitungsgebundenen Energieversorgung. (Communal territorial reorganization and regional energy supply. On the limits of the communal sphere of activity in the field of energy supply transported by wire, mains and lines). Scholz, R. Berlin, Germany, F.R.; Duncker und Humblot (1977). 112p. (In German).

1) The public and private (regional) utilities have the same functional mandate in the public domain, which is legally determined or laid down in the Constitutional Law, the Community Law and the Energy Economy Law. 2) The communal reform of areas does not usually directly affect the position of the regional utilities. Indirect consequences could arise on the basis of legal and moral consequences of newly formed, changed or joint communal regional bodies. 3) From the point of view of area reform and central target setting, in order to create regional bodies having greater output, it is not permitted that communal regional bodies should adversely affect intact and strong regional supply structures from the aspect of concentration. 4) Legally the use of public roads depends on power supply by cables. The determining instrument of the contract is of a private and public legal type. 5) The Community Law obliges every measure concerning public property such as common economic development to comply with the bases of a public supply purpose, an economical and suitable management and to have regard to the private competitor. 6) The same bases arise from the Energy Economy Law. 7) The limits of freedom of community activity are continued in the system of the public road right. 8) Regional utilities which are affected by damaging consequential measures are touched on in article 12 I GG and particularly article 14 GG regarding their basic rights. 9) Consequential community measures, which are based on the communal route monopoly, are bound by the Competition Right. 10) The regional utilities have no absolute protection for their existence in their economic and competitive position in the public domain. From the regulations of the Area Reform Law, the Community Law, the Energy Economy Law, the Roads Law, the Constitutional Law and the Competition Law there are, however, effective safeguards in individual cases.

50485 Energy demand, conservation potential, and probable lifestyle changes. Hearings before the subcommittee on advanced energy technologies and energy conservation research, development, and demonstration of the Committee on Science and Technology, U.S. House of Representatives, Ninety-Fifth Congress, First Session, April 4, 5, 1977, No. 35. Washington, DC; Committee on Science and Technology (1977). 627p. GPO.

The hearings on April 4 and April 5, 1977 were conducted to lay groundwork for pending energy legislation and technology proposals facing the subcommittee. Of particular interest are the differences in energy demand forecasts, the potential for conservation, and the lifestyle changes that may result between now and the 21st century. Many of the witnesses have made forecasts of energy needs over the next 25 years. Each forecast implies some level of annual energy growth rate and some level of conservation, and both imply lifestyle or quality of life changes forced either by price increases or regulations, or both. Witnesses appearing on April 4 were Drs. Chauncy Starr, Gene G. Mannella, John D. Christie, Joel Darmstadter, Richard W. Barnes, and Denis A. Hayes. Drs. John H. Gibbons and William W. Hogan and Professor Lawrence R. Klein were the witnesses on April 5. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 49523, 49524, 50415, 50429, 50453, 50469, 50475, 50478, 50484, 50499, 50595, 51303

50486 (DOE/ERA—0012) **Findings and views concerning the exemption of motor gasoline from the manatory petroleum allocation and price regulations. Supplement to September 1977 report.** (Department of Energy, Washington, D.C. (USA). Office of Regulations and Emergency Planning). May 1978. 71p. Dep. NTIS, PC A04/MF A01.

All of the conclusions presented in the September Report (TID-28102; EAPA 4:2494) remain valid. In summary, it is concluded, as FEA did in the September Report, that motor gasoline is not, and will not be through 1979, in short supply; that competition and market forces are adequate to protect consumers from undue price increases; and that exempting motor gasoline from price and allocation controls will not have an adverse impact on the supply of any oil or refined petroleum product subject to the EPAA and will not result in inequitable prices for any class of user of such oil or product. Finally, it is concluded that the exemption of motor gasoline from allocation and price controls is consistent with and provides for the attainment, to the maximum extent practicable, of the objectives of section 4(b)(1) of the EPAA. After decontrol, the Department of Energy will continue to survey gasoline supply, demand, and prices and analyze and publish the available information. Should this continuing survey and analysis reveal that the prices or supply of motor gasoline are such as to invalidate any of the findings of this report, the Secretary would consider complete or partial reimposition of price or allocation controls.

50487 Working document on energy policy. London; U.K. Dept. of Energy (1977). 89p.

This report considers the objectives of energy policy and the means by which such policies may be implemented; sets the UK energy sector in a world context and considers the various component parts of energy policy-energy conservation, coal, oil, gas, electricity, nuclear power, and research and development (including conservation and alternative sources of energy); examines the environmental aspects of energy policy and the ways in which energy policy interacts with industrial, social, and other policy considerations; and outlines short- and long-term prospects and suggests a long-term strategy.

50488 Solar Sweden. Johansson, T.B.; Steen, P. (Univ. of Lund, Sweden). *Ambio;* **7**: No. 2, 70-74(1978).

The 1977 report "Sol Sverige", published as a contribution to the Swedish Secretariate for Future Studies' project, "Energy and Society", is summarized. The outline of an energy system for Sweden based entirely on domestic and renewable energy sources is set forth. The model could be in full operation in about 35 years without a reduced material standard of living. It is suggested that investments be started soon to facilitate the transition away from oil and gas. Important components in a future energy system include: more-efficient energy use in industry and households; investments in district heating, designing pipes for lower temperatures than used in today's systems, efforts to build up markets for components likely to be used in a large system e.g., solar heating; and studies of land-use

policies and policies within different industrial sectors that might be in conflict with the energy system proposed.

50489 Alternatives of energy policy for the urban area of Munich until 1985. Hanssmann, F.; Fischer, W. *Energiewirtsch. Tagesfragen;* 27: No. 11, 738-743(Nov 1977). (In German).

To formulate an energy policy compromise for medium-term energy planning in the urban area of Munich, a static energy model was developed. This model is applicable in principle to all points of planning for which data of sufficient accuracy are available. The authors analyze the technological basis, some alternative strategies, and alternative environmental scenarios.

50490 Energiepolitik in der BRD von 1950 bis heute. Analyse und Kritik. (Energy policy in the FRG from 1950 until today. Analysis and criticism). Meyer-Renschhausen, M. Koeln, Germany, F.R.; Pahl-Rugenstein (1977). 165p. (In German).

The essay analyzes the change in the electric power industry structure of the FRG from 1950 to 1973, especially with regard to its causes. The various advantages of petroleum and natural gas in comparison with brown and hard coal were the main causes of this important change. The energy policy of the FRG over nearly 2 decades, its measures and their effects on the electric power industry show that the influence of government-guided energy policy is restricted. The development of the power industry is mainly influenced by private-industrial decisions.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 49554, 50444, 50466

COAL

REFER ALSO TO CITATION(S) 49372, 49384, 49429, 49515, 49522, 49523, 49524, 49525, 50516

50491 (TID—28435) **Fuel adjustment clause. Part I. Coal and the coal market: a primer.** Levine, R. (Georgia Office of the Consumers' Utility Counsel, Atlanta (USA)). Mar 1978. 108p. Dep. NTIS, PC A06/MF A01.

The structure and substance of the relationships that constitute the market for steam coal are outlined.

50492 Coal in the U.S. energy market: history and prospects. Gordon, R.L. Lexington, MA; D.C. Heath and Company (1978). 236p.

A survey of the history and prospects of the USA coal industry recognizes two basic problems—the enormous uncertainties that exist about world energy resource endowments and prospective technological progress and the pervasive role of public policy in influencing coal production and use. Chapter 1 deals with public policy and other problems. The following 5 chapters are: The History of U.S. Coal Consumption Patterns; Forecasting Coal Consumption; The Economics of Coal Production and Distribution; The Economics of Coal Utilization; and Scenarios of Electric Utility Fuel Use. (MCW)

50493 Coal for the future: progress with Plan for Coal and prospects to the year 2000. London; Her Majesty's Stationery Office (1977). 23p. Dept. of Energy, London, Eng.

The present report reviews progress in the coal industry since the two reports of the Coal Industry Examination were published in 1974. The National Coal Board's Plan for coal aims at a total annual output of at least 135 million tons by 1985 with the possibility of further increase towards meeting a potential demand of 150 million tons. Progress with the plan is discussed regarding investment, completion timing, benefits of coal investment, exploration, manpower, productivity, coal prices, advantages of opencast coal, and market prospects to 1985. The outlook to the year 2000 is discussed considering demand, research and development, new capacity, coal reserves, planning objectives, exploration, environment, capital requirements, expertise, economics, and the European Community. (MCW)

PETROLEUM

REFER ALSO TO CITATION(S) 49527, 49553, 49571, 50420, 50486

50494 Political economics of offshore oil. Rosing, K.E.; Odell, P.R. (Erasmus Univ., Rotterdam). *Nat. Resour. Forum;* 2: No. 3, 229-239(Apr 1978).

The exploration of offshore areas for hydrocarbons has involved new technical and economic considerations and has posed new problems, not the least of which has been the changing relationship between companies and governments. In this article, the authors present an analysis of the different perspectives and policies that emanate from national governments on the one hand and from transnational oil companies on the other. The issues examined include the considerations involved in establishing exploration legislation, post-discovery problems, the impact on revenues of increased production, the interests of companies in developing fields, and the overall economic environment with which decisions have been agreed.

50495 Aspects of petroleum transport in developing countries. Ketharaman, S. *Nat. Resour. Forum;* 2: No. 3, 241-255(Apr 1978).

Dramatic changes in the institutional structure of the international oil industry in recent years have created new responsibilities and opportunities for developing countries in petroleum transport. The article discusses the prospects for changes in the ownership/control pattern of seaborne oil movements and the need for both oil-producing and oil-importing developing countries to pursue national plans to acquire shipping tonnage and expertise, without being deterred by the present depressed conditions of the world shipping industry. Drawing from the experience in India, it deals with some features and problems of petroleum transport by sea, pipeline, rail, and road. It stresses the importance of cooperation among developing countries through common operation of deep-water terminals and large-size tankers to optimize transport costs.

50496 Statement of proceedings. Thompson, A.R. Vancouver, BC; West Coast Oil Ports Inquiry (1978). 167p.

The proceedings of an inquiry into the environmental, social, and navigational safety aspects of a proposed oil port at Kitimat and the broader Canadian concerns and issues related to West Coast oil tanker traffic are summarized. Following the oil embargo in 1973, and concerned about the peaking of production in Alberta fields, the Government of Canada, through the National Energy Board, initiated a phasing out of exports of Canadian crude oil to the United States. This phasing out is well underway and exports of Alberta crude to the Puget Sound refineries have been reduced to a trickle. The phasing out of Canadian exports of crude oil is also affecting refineries in the Northern Tier states, from Montana to Minnesota, which are dependent upon Alberta crude oil. Now they, too, must find alternative sources of supply. To replace this oil, tankers in the class up to 125,000 DWT are now bringing crude oil from Alaska and Indonesia through the Strait of Juan de Fuca and the Gulf Islands to the docking facilities of the Puget Sound refineries. The United States was thus faced with two distinct yet related problems: supplying crude oil to the Northern Tier states and moving the "Alaska surplus." The search for a solution to these problems led to a number of proposals for new pipelines, three of them directly affecting Canada's west coast. The review of the proceedings includes issues, the opinions of the public, information gained, and what now needs to be done. (MCW)

50497 Recommended basic format for the classification of international data on crude oil and natural gas reserves and resources. *Nat. Resour. Forum;* 2: No. 4, 387-402(Jul 1977).

Report of expert group convened by UN.

Effective assessment of nonrenewable resources is needed, both the availability and the interpretation of basic data. The quality of these data directly affects resource policy decisions based on them. It is vital to bring information on reserves and resources into sharper focus, by clearer definition of what has been measured, by orderly classification and by identification of the results of assessment in a way that stimulates their proper understanding and application. As part of the overall program of the United Nations Center for Natural Resources, Energy and Transport in the field of natural resources, an Expert Group was convened in New York from 28 March to 4 April to discuss a series of such basic questions concerning the international classification and measurement of crude oil and natural gas resources. Key conceptual principles and definitions were agreed as a basic framework within which governments could work towards an internally consistent and comprehensive international exchange of information. The Group also examined problems of measurement and the manner in which existing national data would be incorporated into an international classification. The report of the Group is summarized.

50498 International petroleum annual, 1975. Washington, DC; Bureau of Mines (1977). 38p.

The most significant event for the world petroleum industry in 1976 was that the Organization of Petroleum Exporting Countries (OPEC) held the price of crude oil at the same level that it had agreed upon in Vienna, Austria, in September 1975. At that meeting, OPEC increased their crude oil prices 10 percent and froze those prices at the new level for a period of 9 months. In May 1976, the OPEC ministers held a meeting in Bali but failed to agree on a price increase. The ministers adopted a revised version of Algeria's crude oil pricing differential value system, whereupon some member countries adjusted prices slightly to meet certain situations before their December meeting in Doha, Qatar. During the December meeting

OPEC adopted a two-tier price system, under which 11 members raised their crude oil prices by 10.34 percent effective January 1, 1977, and by 4.72 percent to become effective July 1, 1977. Saudi Arabia and the United Arab Emirates raised their prices 5 percent effective January 1, 1977. During 1976, world demand for crude oil continued to increase above that of 1975. World crude oil production in 1975, excluding the Sino-Soviet area, amounted to 15.2 billion barrels, whereas preliminary figures indicated world production in 1976 to be approximately 16.4 billion barrels. The increase in demand plus the anticipated increase in crude oil prices created large differential tanker rates between the latter part of 1975 and the first 2 months of 1977. Worldwide exploration both onshore and offshore continued at a slow but steady pace in 1976. Major discoveries were reported in Central and South America, North Sea, Mediterranean Sea, Africa, Middle East, Asiatic area, and the Sino-Soviet area. In addition to statistical summaries of the petroleum industry, including by-products, discussions are included on pipeline and refinery expansions and nationalization.

50499 Oil in the Seventies: essays on energy policy. Watkins, C.; Walker, M. (eds.). Vancouver, BC; Fraser Institute (1977). 310p. $3.95.

Seven essays provide, first, a view of petroleum and energy markets as seen through the economist's eyes; and second, analyze a number of vital questions relating to oil policies that governments have adopted or might enact in the future—particularly in response to radical changes in world conditions. A separate abstract was prepared for each essay. (MCW)

50500 Petro-Canada: a national oil company in the Canadian context. Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, First Session. November 1977, Publication No. 95-66. Washington, DC; Committee on Energy and Natural Resources (1977). 68p. GPO.

This study of the Canadian experience provides members of the Senate Committee on Energy and Natural Resources (USA) some perspectives on how Canada has dealt with national oil company issues. The United States is the only oil-exporting and -importing country of consequence that does not have a national oil company. Although no serious consideration has been given to creating such a company, the experience with government companies elsewhere deserves more thoughtful study here than it has received to date. A careful evaluation of the roles of national companies, both in domestic and international energy affairs, could help to determine the potential for such an institution in the U.S. The Canadian National Petroleum Company (Petro-Canada) commenced operations on January 1, 1976. Canada thus joined the growing number of nations that have created government oil companies. While many factors led to the creation of Petro-Canada—including Canadian politics—there seems little doubt that distrust of the role of foreign-controlled oil companies and deep concern about the security of energy supplies following the Arab embargo were major considerations. The existence of Petro-Canada now enables the Canadian government to play a direct role in the petroleum industry. The activities of Petro-Canada to date reflect the government's emphasis upon the need to increase domestic production of oil and gas.

NATURAL GAS

REFER ALSO TO CITATION(S) 49586, 49593, 50419, 50420, 50497

50501 Should considerations of immediate advantages hide long-term decisions from view in gas supply. The problem of quantity assurance in gas supply and its solution with the aid of a combination of nuclear energy and coal gasification. Volkmann, D.J. *Staedtetag;* **30**: No. 6, 331-341(1977). (In German).

The consumption of natural gas — the rarest of the fossil energy carriers — has undergone the highest growth rate. The author poses the question whether the world's natural gas reserves will actually ensure supply without problems beyond the year 2000, and deals with the question of realistic estimates of future import possibilities for natural gas as far as the FRG is concerned. Decisions as regards effective future-oriented measures — modern secondary energy system, promotion of the HTRs, combined system nuclear energy - coal gasification — have to be made soon. The author demonstrates that towards the end of the eighties, a considerable gap in the FRG's supply with natural gas is to be expected.

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 50523

ELECTRIC POWER

REFER ALSO TO CITATION(S) 50419, 50451, 50479, 50484, 50490

50502 (CONS—3885-1) **Evaluation of electrical power alternatives for the Pacific Northwest.** (TRW, Inc., McLean, Va. (USA). Energy Systems Planning Div.). Sep 1977. Contract EX-76-C-10-3885. 255p. Dep. NTIS, PC A12/MF A01.

This study evaluates the concept of implementation of large-scale energy conservation to reduce end-use demand for electrical energy as an alternative to the need for continued construction of new power plants to meet projected energy requirements for the Pacific Northwest. In particular, the numerical accuracy, economic feasibility, and institutional impact of a conservation-oriented scenario developed by the Natural Resources Defense Council, Inc., is assessed, relative to the energy forecast prepared by the Pacific Northwest Utilities Conference Commission. The results of this study are presented in four detailed sections following an introductory and summary section: Reconstruction and Numerical Evaluation of Alternative Scenario; Economic Analysis; Institutional Impact; and Impact of New National Energy Policy.

50503 (EPRI-EM—696) **Assessment of the role of advanced technologies in small utilities. Final report.** Steitz, P.; Mayo, G. (Burns and McDonnell Engineering Co., Kansas City, Mo. (USA)). May 1978. 175p. Dep. NTIS, PC A08/MF A01.

This study assesses the potential role of six advanced technologies in small municipal and rural electric utility systems by comparing the economics of utilizing these advanced technologies with the economics of conventional generation types. The technologies examined include: 5-MW coal-fired diesel engine; 5-MW coal-fired closed-cycle combustion turbine; 2 MW coal-fired Stirling engine; 2 MW oil-fired Stirling enging; 1-MW organic Rankine cycle bottoming on a 5-MW diesel engine; and 1-MW two-phase engine bottoming on a 5-MW diesel engine. Results of the study indicate that if the characteristics assumed for these technologies can be achieved, then: (1) The oil-fired technologies (oil-fired Stirling engine, organic Rankine cycle/diesel, and two-phase engine/diesel) could penetrate a significant portion of the future small utility market. They will most likely be employed as intermediate-duty generators and their actual selling price and heat rate. If the heat rates projected herein are achieved, significant market penetration could be realized at capital costs of $250 to $300 kW in 1975 dollars. (2) The coal-fired technologies (coal-fired diesel, closed-cycle combustion turbine, and coal-fired Stirling engine) are not competitive with base-load capacity from joint-action projects but may be competitive with purchased base load capacity. Specifically, the coal-fired diesel has the lowest break-even capital cost and even allowing for the uncertainties of operation and maintenance costs would be only marginally attractive at a cost above $500/kW. The coal-fired combustion turbine and the coal-fired Stirling engine could be attractive at costs below $450/kW and $650/kW respectively.

50504 (FEA/D—77/082) **Electric utility rate design proposals. Executive summary of interim report.** (Federal Energy Administration, Washington, D.C. (USA). Office of Energy Conservation and Environment). Feb 1977. 18p. Dep. NTIS, PC A02/MF A01.

There has been a growing awareness of the need for a consistent public policy with respect to electric utilities. The central objective of such a policy should be to ensure that adequate and reliable supplies of electricity, efficiently generated from abundant domestic fuels, are available to consumers at just and reasonable prices, and that such supplies are prudently used. Four broad issues have dominated the discussion of utility policy in recent years, and are analyzed in this report: (1) rate-reform and load-management practices to flatten peak demand, and thereby reduce the need for expanded generating capacity; (2) fuel-utilization policies to minimize utility dependence on oil and natural gas; (3) improved power plant reliability, system interconnections, and other measures to reduce required reserve margins without unduly sacrificing system reliability; and (4) utility-financing procedures that maintain the economic viability of the industry and encourage management efficiency. Much of the analysis is based on limited empirical data and, thus, many of the conclusions drawn should be considered tentative. Furthermore, the diversity of the utility industry makes it impossible to formulate generalized conclusions that are equally applicable to all individual utility systems and utility customers.

50505 Econometric assessment of cost savings from coordination in U.S. electric power generation. Christensen, L.R. (Univ. of Wisconsin, Madison); Greene, W.H. *Land Econ.;* **54**: No. 2, 139-155(May 1978).

An econometric model tests the generally held conclusions that coordination of electric utilities and scale economies will result in cost savings. A contractural agreement between utilities is used as the criterion for power pool participation. The analysis differentiates by degree of coordination, region, and size of firm. 1970 cost data

from 138 firms is compared and found to show no support for the theory that firms belonging to power pools are more cost effective, although common ownership had an advantage on the average over individual companies. These findings help to explain why power pooling has not increased. Mergers of small firms have proved to be more efficient and better able to compete than pools of large utilities. 10 references.

50506 Rural electrification: an alternative for the Third World. Usmani, I.H. (United Nations, Geneva). *Nat. Resour. Forum;* **2**: No. 3, 271-277(Apr 1978).

Rural electrification is an essential element in development planning in developing countries. In the past, the conventional approach to rural electrification has been either to extend national grids from central power stations, or to install small diesel generators. This article explores a third alternative, namely the harnessing of such renewable sources of energy as solar, wind, and biomass for the production of local electric power. The author outlines the concept of the Rural Energy Center in comparison with the structure of energy needs, and responds to critics of this integrated approach to the problem of rural electrification.

50507 Exponential growth in the electricity supply industry. Rasokat, H. (Stadtwerke Duesseldorf A.G. (Germany, F.R.). Teilbereich Planung und Anlagenbau Stromnetz). *Elektrizitaetswirtschaft;* **77**: No. 3, 77-87(Jan 1978). (In German).

Since the first publications of the 'Club of Rome' exponential growth has become suspect. Nevertheless, work is still carried out in the electricity supply industry using exponential growth. Can this branch of the economy take the liberty of ignoring Dennis Meadows' index finger which is raised in protest, and still adopt the percent fetish as before. The author follows up the suspicion that exponential growth cannot be proved. The alternative which is of equal value, viz. polynominal growth, avoids the dizzy, high values of the exponential forecasts and explains at the same time the phenomenon of falling rates of growth.

50508 Planning of electric supplies. Muenker, H. *Tech. Mitt. AEG-Telefunken;* **67**: No. 5/6, 209-217(Dec 1977). (In German).

The essential prerequisites, the steps in planning and the tools are described for the planning of the supply networks, which are available as transmission and distribution networks for the various voltage levels. The basic difference between domestic and industrial electric power supply are explained.

50509 Electric power industry of the USSR during the past 60 years of Soviet rule (important events). Steklov, V.Yu. *Teploenergetika (Moscow);* No. 11, 80-86(Nov 1977). (In Russian).

A year-by-year chronicle of the most important events in the development of the Soviet electric power industry and electrical and nuclear engineering from 1917 until 1976 is presented.

50510 Electricity: report of the Secretary of State for Energy for the year ended 31st March 1977. London; Her Majesty's Stationery Office (1977). 15p. 55p net.

In Part I, the proceedings under the Electricity Acts of 1947 and 1957 are summarized--personnel and financing data, acquisition of land, and transfer of assets. Part II contains other financial proceedings under other Acts. Part III contains applications to and proceedings of the Secretary of State under the Electricity (Supply) Acts 1882 to 1936--generating stations, overhead lines, electricity supply regulations 1937, and electricity meters. Part IV tells of the electricity discount scheme. (MCW)

50511 Structure of the electricity supply industry in England and Wales. London; Her Majesty's Stationery Office (1976). 75p. 95 p net.

The examination of the structure of the electric supply industry in England and Wales is performed by first reviewing its features between nationalization in 1948 and the Electricity Act of 1957 (Part II). Part III then looks at developments since 1958 while the next section recognizes the need for change. A unified industry is the solution recommended in Section V. Other possible structures are examined in the next section followed by topics on the organization of a unified industry, its personnel, government involvement, and consumer representation. (MCW)

50512 Impact on testing of rising utilities costs. Roy, J.A. (Martin Marietta Corp., Baltimore). pp 342-344 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

The oil crisis has had an impact on homes, automobiles, and also, unfortunately, on laboratories. Expensive oil begins a chain of increased lab operational costs including electricity for lighting, equipment operation, heating and air conditioning; liquid and gaseous nitrogen for cooling, cleaning, etc; and water. The author illustrates the upward cost trends of these items and some of the actions taken as a result.

50513 (ORNL-tr—4563) **Law, technology, and economics. Volume 4. The reliability of the study of energy: is it now in jeopardy and by what remedial measures is it being increased.** [nd]. Translated by J. Crabbs from pp 49-74 of German report. (CONF-731223—2). 28p. Dep. NTIS, PC A03/MF A01.

From Meeting on how to ensure the energy supply, possible dangers and ways and means to improve energy supplies in the future; Bielefeld, F.R. Germany (7 Dec 1973).

The speakers on the topic: Construction Reliability of Facilities and Power Grids--Zoning Procedure were Professor D. Bluemel and Assessor von Keiser with Attorney Dr. Kuhnt as the discussion leader. Comments on the establishment of a Legal Zoning Institute apply to the regular procedure in the construction of power supply facilities, including nuclear facilities. 140 references. (MCW)

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 50435, 50455

50514 Estimation of a production technology: a survey of econometric analyses of steam-electric generation. Cowing, T.G. (State Univ. of New York, Binghamton); Smith, V.K. *Land Econ.;* **54**: No. 2, 156-186(May 1978).

Econometric studies that identify fuel, capital, and labor as the primary inputs of steam-electric production technologies are reviewed. Production function and input requirement studies were made by Komiya (1962), Galatin (1968) and Courville (1974); input demand studies by Barzel (1964, Dhrymes and Kurz (1964), McFadden (1964), Belinfante (1969), Cowes (1974), Boyes (1976), and Fuss (1970); cost equation studies by Nerlove (1963), Petersen (1975), and Christensen and Greene (1976); profit function by Atkinson-Halvorsen (1975). The studies generally agree that scale economies are possible and that labor and fuel savings accompany technical change. Further studies are called for to aid in understanding the implications of resource-allocation choices. 71 references.

50515 Planning for uncertainty. *EPRI J.;* **3**: No. 4, 6-11(May 1978).

Uncertainties surrounding future power demand and the long lead time for facility construction, which has made utility planning difficult, may result in large reserve capacity being more economical than a possible shortfall. Utility planners who must deal with users having conflicting views about reliability and expansion are advised to include demand uncertainty when planning for capacity. The Electric Power Research Institute (EPRI) has developed a model for building a flexible power system able to respond to demand growth as it occurs. Cost accounting is separated into four categories: fixed, variable, outage, and environmental, with outage costs representing society's demand for reliability and efficiency. An asymmetrical U-shaped curve develops and indicates that undercapacity can be more costly than a higher planning reserve if demand turns out to be consistently higher than was expected.

50516 Market potential for new coal technologies. Spencer, D.; Gildersleeve, O. *EPRI J.;* **3**: No. 4, 19-26(May 1978).

Estimates of the regional market potential during the period 1985 to 2005 are developed for 12 coal technology options using six utility models as a tool for setting research and development priorities. Generation-expansion techniques are used to define an appropriate mix of technologies, determine the market penetration and technological improvements needed for each, and analyze the economics of each technology. Utility data inputs include capital costs, fuel costs, operation and maintenance costs, unit availability, escalation, and fuel price sensitivity. Twelve options for coal firing using boilers or in combined cycles were studied along with other types of power plants. Comparisons of the resulting figures with planned research efforts by the Electric Research Institute (EPRI) and DOE leads to the conclusion that the current cost-to-benefit ratio of Federal and utility investment of 2 : 1 are adequate to meet electric utility requirements. EPRI plans to expand and validate this preliminary analysis.

50517 Ellis T. Cox: pragmatist with a public conscience. *EPRI J.;* **3**: No. 4, 27-30(May 1978).

A profile of Potomac Electric Power Co. executive Ellis T. Cox EPRI Advisory Board member the obligation he feels for preserving the unique qualities of the Washington, D.C. area by installing power plant pollution equipment, burning low-sulfur coal, and setting an example of concern for other companies and the legislators. Cox feels a commitment to not only meet civic responsibilities, but to demonstrate that an efficient, cost-effective company can also protect the environment. He sets long-term fuel supplies as a high priority for utility research and development and sees no alternative to shifts away from petroleum and further development of nuclear generating power. His other concerns are for streamlining

the regulatory process, demonstrating the Civex process as an alternative fuel cycle, and a continuation of the joint efforts of utilities and the Electric Power Research Institute to solve practical problems of pollution control and develop new fuels and new combustion technologies.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 50615

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 49792, 50463, 50464, 50465, 50468, 50477, 50547, 50548, 50599

50518 (CONF-780443—1) **Impact of the end-use energy system.** Tison, R.R. (Institute of Gas Technology, Chicago, Ill. (USA)). 1978. 7p. Inst. of Gas Tech., Chicago, IL.

From 2. conference on alternate energy; Palm Springs, CA, USA (8 Apr 1978).

The paper addresses the impact of the residential end-use energy system, specifically, the impacts of two aspects of residential energy end use and end-use systems. These aspects are consumption/savings and load patterns and existing equipment. Community energy-system guidelines, resulting from the combination of these two aspects with the energy distribution system, are also discussed.

50519 **Energy gap in the Land of the Rising Sun.** Martin, D. *Process Eng.;* 107(Apr 1978).

Japan, one of the largest consumers of energy in the world, depends to the extent of about 90% on overseas resources. Thus changes in the supply and price of energy, especially oil, have a particularly severe effect on the Japanese economy. A discussion is given on how the Japanese are coping with the energy gap and on energy saving with pollution control.

50520 **Estimating cost functions for rail rapid-transit properties.** Pozdena, R.J. (SRI International, Menlo Park, CA); Merewitz, L. *Transp. Res.;* **12**: No. 2, 73-78(Apr 1978).

Using data from North American rail transit properties, short- and long-run cost functions are estimated using a neoclassical economic model. Various special econometric techniques are employed to estimate the relationships from a heterogeneous data set. The estimated cost functions are then used to forecast the cost experience of the BART system in San Francisco.

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 50483, 50488

SOLAR

REFER ALSO TO CITATION(S) 49775, 49782, 49788, 50506

50521 (NP—23220) **Interpreting the results of the Atlas report "Energy savings resulting from incremental insulation and incremental solar system capacity" relative to AB 1558 tax-credit guidelines.** Carner, D.; Heintz, M. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). 14 Dec 1977. 57p. Energy Resources Conservation and Development Commission, Sacramento, CA.

AB 1558 creates a 55% state tax credit up to $3,000 for installation of solar systems that produce heat, cool, or electricity. Conservation measures applied in conjunction with such solar systems, which reduce the first cost or increase the energy savings of such systems, may also be eligible for the tax credit. The ERCDC is directed by this legislation to develop solar-system eligibility criteria for the tax credit. The immediate concern of the Conservation Division has been to investigate the feasibility of developing simplified rules of thumb that could be applied in conjunction with the solar-system eligibility criteria currently being developed by the energy commission. Ideal rules of thumb are listed. Accordingly, the Conservation Division of ERCDC recently entered into an agreement with Atlas Corporation to analyze the trade-offs between: reducing thermal loads through retrofitting various conservation measures and supplying those loads (domestic space and hot water) with active solar technology. The November 30, 1977 report entitled "Energy Savings Resulting from Incremental Insulation and Incremental Solar System Capacity Preliminary Report" was circulated to the public and has received several helpful criticisms and questions relating to the scope of the analysis and interpretation of its findings. This discussion is directed towards clarifying these concerns. (MCW)

GEOTHERMAL

50522 **Geothermal energy in transition.** McNitt, J. (United Nations, Geneva). *Nat. Resour. Forum;* **2**: No. 1, 5-17(Oct 1977).

At a time when future sources of energy are under close scrutiny, both in terms of availability and suitability, geothermal energy ranks among the candidates for inclusion in any appraisal of alternative forms of supply. The use of geothermal energy for the production of electricity and for supplying domestic and industrial heat is a comparatively recent phenomenon, and its application remains closely constrained by favorable geological conditions. Yet, exploration in several countries shows that geothermal energy may emerge as an important adjunct to total energy supply in many localities. McNitt outlines some of the economic and technological parameters of this energy source. Small-scale geothermal power stations are more economic and less capital-intensive than conventional plants, which make them of particular interest for developing countries with small electricity systems and competing demands on limited capital resources. The principal capital expenditures in the development of geothermal sources include exploration, steam production, installation of generating plant, and the cost of effluent disposal. The wider use of low-grade geothermal heat is also examined, in addition to the environmental problems occurring in the development of geothermal energy. The scope for technical cooperation in the development of geothermal energy is substantial, and it is likely that this source of energy will undergo more-intensive development on the local scale in the future.

OTHER

REFER ALSO TO CITATION(S) 50524, 50528

50523 (DOE/US—0001/2) **Alcohol fuels program plan.** (Department of Energy, Washington, D.C. (USA). Alcohol Fuels Program). Mar 1978. 59p. Dep. NTIS, PC A04/MF A01.

The Department of Energy has considered the production and use of ethanol and methanol as liquid fuels. The Task Force on Alcohol Fuels has reviewed the status of alcohol-related activities within DOE and elsewhere and has formulated a plan of action to (1) help resolve uncertainties, and (2) provide options supportive of potential national decisions in this area. DOE is currently conducting a fuels Supply Strategy Study which will consider all candidate alternative fuels and emphasize contingency planning to ensure an acceptable balance between supply and demand under future contingency cases. The special studies included in the Immediate Action Element will provide analyses of key-issue areas for alcohol fuels to support the fuels Supply Strategy Study. These special studies will examine the following aspects of alcohol fuels use: (1) resource availability, (2) economic, environmental, and social impacts, (3) end-use applications, (4) Federal fiscal consequences, (5) industry incentives, and (6) policy instruments for price control, market assurance, and import control. Background information and the program rationale are discussed and a comprehensive outline of the proposed commercialization studies is presented. (MCW)

ENERGY CONVERSION

MHD GENERATORS

50524 (DOE/EDP—0009) **Environmental Development Plan (EDP): magnetohydrodynamics program, FY 1977.** (Department of Energy, Washington, D.C. (USA)). Mar 1978. 153p. Dep. NTIS, PC A08/MF A01.

This magnetohydrodynamics (MHD) EDP identifies and examines the environmental, health, and safety issues concerning the development of the ERDA Magnetohydrodynamics Program, the environmental activities needed to resolve these issues, applicable ongoing and completed research, and a time-phased action plan for the evaluation and mitigation of environmental impacts. A schedule for environmental research, assessment, and other activities is laid out. The purpose of the EDP is to identify environmental issues and to specify actions to ensure the environmental acceptability of commercial energy technologies being developed by ERDA. The EDP also will assist in coordinating ERDA's environmental activities with those of other government agencies. This document addresses the following technologies associated with ERDA's MHD program: (1) open-cycle magnetohydrodynamics; (2) closed-cycle plasma magnetohydrodynamics; and (3) closed-cycle liquid metal magnetohydrodynamics. The proposed environmental action plan is designed to meet the following objectives: (1) develop methods for

monitoring and measuring emissions; (2) characterize air emissions, water effluents, and solid wastes from MHD; (3) determine potential environmental impacts and health hazards associated with MHD; (4) model pollutant transport and transformation; (5) ensure adequate control of pollutant emissions; (6) identify and minimize occupational health and safety hazards; (7) prepare NEPA compliance documents; and (8) assess the environmental, health, and safety impacts of the commercialized industry. This EDP will be updated and revised annually to take into account the progress of technologies toward commercialization, the environmental work accomplished, and the resolution of outstanding environmental issues concerning the technologies. (WHK)

50525 Method for taking account of the effect of chemical kinetics on the thermodynamic properties of the working body in supersonic MHD generators. Prusov, N.M.; Pshenichnov, N.N. (Power Institute, Siberian Branch of the Academy of Sciences of the USSR). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 905-910(Mar 1978).

The article proposes a system of kinetic equations which is minimally required for engineering calculations, and an effective method for its solution. The results of claculations using the method developed and an "exact" method are compared. An investigation is made of the effect of error in the rate constants of the cehemical reactions on the compositon of the working body. The results of calculations of the deviation of the compositon and thermodynamic properties from their equilibrium values allow of a conclusion as to the importance of taking account of chemical nonequilibrium for some working conditions of an open-cycle supersonic MHD generator.

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 50536

50526 MHD heat transfer problems: an overview. Postlethwaite, A.W.; Sluyer, M.M. (US ERDA, Washington, DC). *Mech. Eng.;* **10**: No. 3, 32-39(Mar 1978).

The primary system being considered by ERDA is an open-cycle MHD/steam cycle power loop. This article discusses some of the principal heat transfer problems associated with a coal-fired open-cycle MHD system which employs a directly fired air preheater system. Some of the heat transfer problems mentioned here can apply to other systems; however, many are restricted to the system proposed, and the detailed design will concentrate on these problems. The temperatures of the combustion gas associated with various components of the system are listed. The primary heat transfer problems are related to those associated with the MHD topping cycle. The designer must address the problem of seed effects on the components of the steam superheaters and its effect on heat transfer. Four components of the MHD system represent primary challenges to the thermal engineer. These are the combustor, MHD channel, radiant boiler, and the high-temperature air preheater. An important facet of the solution relates to an understanding of the thermodynamics and kinetics of the combustion process and subsequent flow of the combustion products through the system. 23 refs.

50527 Indian experimental MHD unit. Ramaprasad, V.R. (Indian Company for Heavy Electrical Equipment, Design Office for MHD-units, Madras, India). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 911-917(Mar 1978).

The article discusses some of the energy problems of India, the Indian national MHD program, and gives a description and the parameters of an Indian experimental MHD unit.

50528 US aims at commercial coal-fired MHD in the 1990s. Smock, B. *Arch. Energiewirtsch.;* **32**: No. 2, 85-91(Feb 1978). (In German).

The driving force behind MHD research in the USA is the desire to tap the country's mighty coal reserves with a highly efficient environmentally favorable process. The aim of the national MHD research program, carried out by ERDA, is to develop a commercially feasible process of electricity generation with the aid of a combined MHD/steam cycle by the year 1989.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 50539

50529 (CONF-780307—4) **Experimental investigation of rotating-drum separators for liquid-metal MHD applications.** Lenzo, C.S.; Dauzvardis, P.V.; Hantman, R.G. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From 17. symposium on engineering aspects of MHD; Stanford, CA, USA (27 Mar 1978).

Portions of document are illegible.

For the past several years, Argonne National Laboratory has been active in the development of closed-cycle two-phase-flow MHD power systems. One of the key components in such systems is an effective and efficient gas-liquid separator-diffuser. On the basis of an assessment of present technology, it was decided to study the characteristics of a rotating drum type of separator, and a multitask research and development program was initiated within the overall liquid-metal MHD research program. The first task, now completed, centered on the investigation of single-phase flow (liquid) deposited by a flow nozzle on the inner surface of freely-rotating cylinders or drums of 423 mm and 282 mm diam. The tests were designed to study the recovery of energy in the liquid layer deposited on the drum; the torque transmitted to the drum by the liquid as the result of shear stress between the liquid and the drum surface; the characteristics of the liquid layer; and the effects of drum size, nozzle shape and orientation, and nozzle velocity. The test results showed that a stable liquid film was formed on the drum and that the kinetic energy of the liquid layer was high enough to be potentially useful in two-phase-flow MHD power systems.

50530 (CONF-780307—5) **Slag and seed deposition on heat exchanger surfaces from gas-droplet mixtures.** Im, K.H.; Chung, P.M.; Carlson, L.W. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 10p. Dep. NTIS, MF A01.

From 17. symposium on engineering aspects of MHD; Stanford, CA, USA (27 Mar 1978).

Portions of document are illegible.

Mechanisms of particulate deposition from turbulent streams to solid surfaces are first discussed. Two problems of current interest in MHD application are then analyzed. One is the collection of slag droplets on the interior wall of vertical tubes from the turbulent droplet-laden gas stream. Such processes take place during the cycle of the regenerative heat exchanger used to preheat combustion air. The other is the removal of sub-micron-size slag particles or collection of seed by a bank of staggered vertical tubes situated normal to the gas flow direction. Removal of both vapor and droplet phases of slag and seed is possible with such a system. While thermophoresis is found to be a strong function of the temperature difference between the gas stream and the film surface, it was found that lowering of the tube temperature may not greatly enhance the deposition rate because the lower temperature implies a thicker slag film, and the necessary temperature difference is not correspondingly increased.

50531 (CONF-780307—6) **Two-phase LMMHD mixer-development experiments.** Fabris, G.; Dunn, P.F.; Chow, J.C.F. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 8p. Dep. NTIS, MF A01.

From 17. symposium on engineering aspects of MHD; Stanford, CA, USA (27 Mar 1978).

The results of a series of experiments conducted to evaluate the fluid mechanical performance of various two-phase LMMHD mixer designs are presented. The results from both flow visualization studies of the local two-phase flows downstream from various mixer-element configurations and local measurements performed to characterize these flows are presented. A conceptual LMMHD mixer design is described that insures the generation of small bubbles, prevents the formation of gas slugs and separated regions, and favors the stabilization of a homogeneous foam flow.

50532 (CONF-780307—9) **Fabrication and testing of MHD electrodes containing an integral leadout/attachment system.** Hafstrom, J.W.; Dusek, J.T. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From 17. symposium on engineering aspects of MHD; Stanford, CA, USA (27 Mar 1978).

Portions of document are illegible.

A promising technique for the fabrication of HfO_2-base ceramic electrode systems for coal-fired MHD generators is described. The electrodes are designed to withstand a surface temperature of approximately 1800°C (partially slagging walls) and seed/slag attack. They are formed by hot pressing and contain a novel integral wire-mesh electrical leadout/attachment system that is cofabricated with the ceramic electrode body. This approach provides a mechanically strong interface for brazing the electrode directly to the cooling frames or to a mechanical attachment scheme without additional process steps. The electrodes have been successfully tested for 20 h under simulated MHD generator conditions. The fabrication concept is being extended to $LaCrO_3$-base materials.

50533 (FE—2285-19) **Design of superconducting magnets for MHD applications. Final technical report, February 1976—June 1977.** Hatch, A.M.; Becker, F.E.; Ackerman, R.A.; Rhodenizer, R.L.; Markiewicz, W.D.; Hay, R.D.; Langton, W.G. (Avco-Everett Research Lab., Inc., Everett, Mass. (USA)). Jun 1977. Contract EX-76-C-01-2285. 336p. Dep. NTIS, PC A15/MF A01.

The work accomplished and the results obtained in preparing and evaluating designs for base-load size and test facility (ETF) size superconducting MHD magnets are summarized. In Phase I of the

program alternate conceptual designs were prepared for base-load magnets with 6 T central magnetic field. In addition, 5 T and 7 T variations were investigated, two 6 T conceptual designs were scaled down to the ETF size and the several design concepts and variations were compared. In Phase II of the program, selected 6 T design concepts were upgraded to preliminary designs, including two base-load designs and one ETF design. The critical aspects of the designs were examined and the state-of-the-art was evaluated based on the engineering experience gained in the design effort. Descriptions of the various designs are presented supplemented by data tables and preliminary layout drawings. Critical areas, both technical and manufacturing, are discussed and recommendations are made covering R and D, analytical work, modeling and manufacturing investigations that should be implemented in order that large MHD magnet can be built when needed, with assurance of meeting performance, reliability and economic objectives.

DUCT ENGINEERING AND FLUID DYNAMICS

50534 (CONF-780307—3) **Two-dimensional MHD channel design and sectional optimization with physical constraints.** Doss, E.; Geyer, H. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 10p. Dep. NTIS, MF A01.

From 17. symposium on engineering aspects of MHD; Stanford, CA, USA (27 Mar 1978).

Portions of document are illegible.

Two points important to the progress of MHD channel modeling are discussed: the capability of designing an MHD channel by using a two-dimensional model, and the optimization of the power output of the channel by using a sectional optimization procedure. Three design modes of operation, the velocity, Mach number, and pressure modes, are developed. For the same operating conditions, the results of these modes are in excellent agreement with the results obtained with the original design, where the area is specified (area or off-design mode of operation). In regard to optimization, the effects of combustor pressure, Mach number, channel length, load factor, and magnetic field strength on the performance of a Faraday channel are investigated. The effects of parameters such as load current and diagonalization angle are investigated, also, for a diagonal channel. Physical constraints, such as diffuser exit pressure, maximum allowable Hall field, and current density, are imposed on the problem. The results show that the physical constraints play an important role in the optimization of MHD channel performance. The optimization process can also identify the optimal variation of design parameters along the channel for maximum output power yield.

50535 (FE—2341-3) **High Magnetic Field MHD Generator Program. Annual report, July 1976—June 1977.** Eustis, R.H.; Kruger, C.H.; Mitchner, M.; Self, S.A.; Koester, J.K. (Stanford Univ., Calif. (USA). High Temperature Gasdynamics Lab.). Jul 1977. Contract EX-76-C-01-2341. 60p. Dep. NTIS, PC A04/MF A01.

The objective of the program is to investigate the high magnetic field effects in MHD channels which will influence the design of large scale generators. The work includes the study at high fields of (1) plasma nonuniformities and instabilities and (2) boundary layer and Hall field phenomena. In addition a third activity is centered on the existing Stanford 6 tesla magnet where small scale linear and disk channels are investigated. Technical progress is described in detail.

50536 (FE—2519-2) **MHD generator component development. Quarterly report for April 1977—June 1977.** (Avco-Everett Research Lab., Inc., Everett, Mass. (USA)). Aug 1977. Contract EF-77-C-01-2519. 120p. Dep. NTIS, PC A06/MF A01.

The overall objectives of this program are the design, fabrication and delivery of test channels (nozzle, channel, diffuser, instrumentation and controls, and all necessary facility service connections) to the CDIF for MHD generator tests. These CDIF test channels will be driven by a coal combustor which is under development at PERC in parallel with this program. Progress is reported on the following tasks: (1) Conduct basic engineering tests and perform necessary analytical work to define preferred design configurations of the CDIF channel in relation to fluid dynamics and electrodynamic performance. (2) Conduct basic engineering tests and perform necessary analytical work to define preferred electrode module design, side wall construction, wall materials, and fabrication methods for a high performance, durable MHD channel. (3) Conduct basic engineering tests and perform necessary analytical work to define instrumentation and controls and preferred inverter systems and/or channel electrical controls in relation to inverter requirements and operating stability. (4) Determine basic performance capability of the disk generator design under conditions simulating an open cycle MHD plasma. (5) Maintain continuous design and engineering liaison with the Pittsburgh Energy Research Center (PERC) in the development of the two stage CDIF coal combustor. Ensure design compatibility of the integrated combustor-generator system. Design, build, and deliver to PERC an instrumented test section to assist in the design and performance evaluation of the PERC subscale 5 MWt experimental combustor. Obtain quantitative chemical and physical data on relevant coal slags with the PERC experimental combustor. (6) Conduct necessary bench tests to establish essential design information on fluid dynamic, heat transfer, and current transfer characteristics of selected MHD coal slags.

50537 (SAND—78-0925) **Numerical codes for MHD flows. Quarterly technical progress report, January—March 1978.** Touryan, K.J.; Blottner, F.G.; Russo, A.J.; Taylor, J.G. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 31p. Dep. NTIS, PC A03/MF A01.

The objective of this contract is to develop numerical techniques and codes for characterizing coal-combustion-operated MHD generators and diffusers. The purpose for this activity is two-fold: (a) provide the MHD Division of the Department of Energy with evaluative guidelines in selecting and exercising channel codes; (b) provide users with codes to design MHD channel/diffusers and evaluate their performance. The scope of work calls for four tasks: (1) Unsteady one-dimensional channel code: to modify an existing time-dependent code to include MHD effects for approximate predictions of the flow from the combustion chamber through the diffuser. (2) Multidimensional channel codes: to develop codes for predicting the complete inviscid-viscous flow across the duct in an MHD generator and diffuser. (3) Slag layer studies and heat transfer analyses: to adapt an existing code to predict the stability conditions of slag layers which are driven by turbulent exterior flows and to develop a code for predicting slag layer growth. (4) Arc formation, migration, and electrode erosion: to conduct transient analyses in evaluating the inter-electrode arcing and constricted discharges from the gas to the electrode in the presence of Hall current. Progress is reported.

50538 **Selection of the optimal configuration of the frame and the form of the transverse cross section of a frame-type MHD channel.** Bityurin, V.A.; Medin, S.A. (High-Temperature Institute, Academy of Sciences of the USSR). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 918-925(Mar 1978).

A solution is given to a variational problem of the distribution of the current and the potential in the plane of the transverse cross section of an MHD channel. It is shown that, for arbitrary distributions of the conductivity and the velocity in the transverse cross section of of the channel, a maximum of the power is realized with an integral condition for the reversion of the longitudinal current of zero. In the case of a homogeneous distribution of the velocity and two-dimensional inhomogeneity of the distribution of the conductivity, the distribution of the potential at the walls of an optimal channel is linear, i.e., the walls of such a channel can be formed by flat conducting frames. For two-dimensional inhomogeneities in the distribution of the velocity and the conductivity, a numerical variational solution is obtained for a rectangular channel. It is shown that the curvature of the frames in such a channel for typical parameters is insignificant and that the difference in the values of power of an optimal channel and a channel with flat frames is not great. In the case of an absolute maximum of the power, the values of the longitudinal electric field and the mean transverse current, determined by a variational solution and by an optimized solution, for a channel with flat frames, always coincide. On the basis of a numerical solution of the direct electrodynamic problem, an investigation is made of the effect of the form of the transverse cross section of a channel with flat frames on its characteristics. It is shown that channels of elliptical (or round) form have considerable advantages over rectangular channels.

50539 (ANL-Trans—1122) **Investigation of the processes caused by the use of an alkali additive in MHD units operating on natural gas.** Styrikovich, M.A.; Mostinskii, I.L. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). Feb 1978. Translation of Preprint 2-001, 1976. 141p. Dep. NTIS, PC A07/MF A01.

Various ways of injecting and extracting an ionizing additive as applied to open-cycle magnetohydrodynamic (MHD) power production units operating on sulfur-free gaseous organic fuel are discussed. The physical-chemical conversion of the additive and the heat and mass transfer processes caused by its use were investigated on the U-02 experimental MHD unit and on laboratory test assemblies. Engineering methods are given for calculating the processes of additive droplet vaporization, condensation and the precipitation of submicron particles of K_2CO_3 on the heat exchange surface. 62 references.

THERMIONIC CONVERTERS

DESIGN AND DEVELOPMENT

50540 (TID—28239) **ERDA/NASA Advanced Thermionic Technology Program. Progress report No. 25. Report No. TE4220/4233-14-78.** Toy, A. (Thermo Electron Corp., Waltham, Mass. (USA)). Jul 1977. Contract EY-76-C-02-3056. 25p. Dep. NTIS, PC A02/MF A01.

Progress is reported in the areas of (1) surface studies (surface theory, surface characterization chamber, activation chamber), (2) plasma studies (converter theory, enhanced mode conversion), (3) converter development (low-temperature conversion experiments, high-efficiency converter experiments), and (4) hot shell development. (WHK)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 50540

50541 **Cesium-coated graphite emitter. I.** Morozov, A.N.; Lyam, A.L.; Baranov, G.D. *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **22**: No. 12, 1463-1465(Dec 1977).

An experimental study is made of cesium-coated, anisotropic, type PGV-1 pyrolytic graphite as the cathode material for a thermionic cell. Experiments have been carried out over the temperature range 846—1046 °K for the cathode and over the range 452—501 °K for the cesium reservoir. A current density of 75 A/cm^2 is achieved at anode voltages of 1—2 V. This current density shows that cesium-coated graphite has a good emission capability. The emission is observed from the surface of the pyrolytic graphite in the direction perpendicular to the stratification direction.

FUEL CELLS

DESIGN AND DEVELOPMENT

50542 **H_2/O_2 fuel cell assemblies with higher power densities.** Strasser, K.; Gruene, H.; Gutbier, H.B. (Forschungslaboratorien der Siemens AG, Erlangen, Ger.). pp 569-592 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

In recent years, a series of H_2/O_2 fuel cell assemblies with alkaline electrolyte have been constructed and tested by Siemens. Based on the results obtained and with a view to increasing the power density, a 7 kW compact assembly was developed which yielded (without the recooling of the circulating water) power ratios of approximately 10 kg/kW and 8 l/kW respectively. The main feature of this construction is the integration of all the auxiliary units which are necessary for the autogenous operation into a module. The assembly is assembled essentially from a fuel cell battery, an electrolyte regenerator and a monitoring device as the functional units. The battery contains 70 cells switched in series and can be loaded with ca 400 mA/cm^2 at 80°C when operating with hydrogen and oxygen. The electrodes have an active area of 340 cm^2 each. Raney-nickel (anode) and doped silver (cathode) are used as catalysts. The water of reaction formed and the heat losses from the circulating electrolyte are removed in the electrolyte regenerator. The constructional features of the functional units and the finishing processes as well as the electrode behavior under operation are considered in detail.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 50542

MATERIALS, COMPONENTS, AND AUXILIARIES

50543 **Platinum-impregnated pyropolymer refractory composites: a new fuel cell electrocatalyst.** Welsh, L.B. (UOP Inc., Des Plaines, IL); Youtsey, K.J.; Hervert, G.L.; Leyerle, R.W.; Baker, B.S.; George, M.A. pp 593-605 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976).

See CONF-7609175—.

A new class of electrically-conducting, high surface area electrocatalysts is being evaluated in gas diffusion electrodes for phosphoric acid fuel cells operating from 140 to 180°C. These materials are platinum-impregnated composite structures consisting of pyropolymer films bonded to refractory substrates. Performance and lifetime tests are discussed using these electrocatalysts as cathodes in cells with platinum-black counter electrodes. Stable cell performance is obtained from 140 to 180°C during 500 to 2000 h life tests. The chemical and physical properties of these materials are discussed to indicate the variations in electrocatalyst properties available using these materials.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

50544 **Simulation as an instrument for energy planning.** Schoeler, U. (Kernforschunsanlage Juelich, Ger.). pp 263-272 of UKSC 78. Proceedings of the 1978 UKSC conference on computer simulation. Surrey, England; IPC House (1978).

From UKSC conference on computer simulation; Chester, UK (Apr 1978).

See CONF-780439—.

On behalf of the European Communities, the system analysis group of the Kernforschungsanlage Juelich has developed a dynamic energy model which can be used as a common instrument for energy planning for the countries of the European Communities. The characteristic elements and the overall structure of this simulation model are described. Furthermore some examples of applications of the model are given for the Federal Republic of Germany as a pilot country.

50545 **Thrifty handling of energy.** Borst, W. (Wuerzburg Univ. (Germany, F.R.). Physikalisches Inst.). *Phys. Unserer Zeit;* **8**: No. 5, 131-145(Sep 1977). (In German).

First of all, the terms energy, exergy and anergy are explained. It is shown, that the term energy is too broad to make immediately plain that in it is contained the capability of carrying out work. In contrast, the exergy efficiency rate, the second law efficiency, in connection with the utilization of a given energy source in a given system immediately supplies the quantitative measure based on thermodynamical principles as to whether there exists a good or bad adaptation between the used form of energy and the utilization system. This is illustrated by typical examples.

50546 **Primary energy consumption in the Federal Republic of Germany during the first half year 1977.** Gabel, R. *Glueckauf;* **113**: No. 17, 881-882(Sep 1977). (In German).

50547 **Social structure of the American energy consumption.** Boehmer, J. *BP Kurier;* **29**: No. 3/4, 8-9(1977). (In German).

A study on energy consumption in American households on behalf of the 'Washington Center for Metropolitan Studies' (WCMS), which has recently been published, is commented on.

BUILDINGS

REFER ALSO TO CITATION(S) 49962, 49963, 50410, 50460, 50462, 50467, 50518, 50521, 50614, 50618

50548 (CONF-761156—, pp 1-13) **Energy required in poultry production.** Reece, F.N. (South Central Poultry Research Lab., Mississippi State, MS). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

The magnitude of the energy inputs are outlined for poultry production and the sources of energy delineated. Sensible heat output from the birds is a major source of energy for heating poultry houses. Housing type and management practices affect the total energy input for poultry production, as well as the ratios of energy from various sources. Feed energy input, which is the major source of energy for broiler production, is influenced by housing type and the environmental temperature in the house. Fuel energy input for heating the house, which is the major energy input during the first 2 to 3 weeks for broiler production, is drastically influenced by housing type, climatic conditions, and management practices. Management practices such as limited-area brooding can significantly reduce fuel required for brooding poultry. Electric energy input, which is the lowest input for poultry production, is required mainly for providing light and powering mechanical ventilation systems in environmental housing; highest electrical energy requirements occur in environmental housing in summer.

50549 (FEA/D—76/299) **Energy conservation and window systems. Conservation Paper Number 56.** (Federal Energy Administration, Washington, D.C. (USA)). Jul 1976. 103p. Dep. NTIS, PC A06/MF A01.

An assessment is made of the role of the architectural window as an important factor in reducing energy consumption for residential and commercial climate control. The cost-effectiveness of many existing and modified window systems is evaluated. Some of the suggestions, if implemented, would cost-effectively reduce energy consumption while maintaining high aesthetic standards.

50550 (HCP/M60851—01) **Development and implementation of energy building code. Final report.** (Massachusetts Building Code Commission, Boston, Mass. (USA)). Dec 1977. Contract EM-76-F-01-8132. 98p. Dep. NTIS, PC A05/MF A01.

The development by the State of Massachussetts of energy conservation regulations for all new building construction is discussed. This energy building code developed standards for the thermal performance and for the lighting systems of buildings. A training program for familiarizing building officials with the energy building code was developed, and a technical information center for answering questions about the energy code was established. Details of these activities are presented. (LCL)

50551 (TID—28034) **Feasibility of a district cooling system utilizing cold seawater. Phase I: final report.** Hirshman, J.; Whithaus, D.A.; Brooks, I.H. (Tracor Marine, Port Everglades, Fla. (USA); Nova Univ., Dania, Fla. (USA). Physical Oceanographic Lab.). 16 Jun 1975. Contract EY-76-C-05-4875. 113p. Dep. NTIS, PC A06/MF A01.

The feasibility of using cold seawater to directly cool buildings was examined in several locations where a year-round source of cold seawater close to shore coincides with a high year-round air conditioning demand. The first phase of the study indicates the concept is technically and economically feasible and can save 70 to 80% of the electrical energy currently used for air conditioning or 35 to 40% of total electrical energy in the areas serviced. Of the four potential sites studied, Miami/Ft. Lauderdale and Honolulu are most suitable for early development of this concept. Second phase feasibility work should emphasize a specialized pipeline and pipeline installation design for large diameter deep seawater intakes and long-term time-series temperature measurements at potential intake sites. The pipeline design work is necessary to verify preliminary cost estimates and near term feasibility. Measurements are needed to verify the long term stability of the cold water source.

50552 Effect of wind speed upon heat requirements and internal temperatures. Miller, L.M. *Heat. Vent. Eng.;* **52**: No. 607, 5-6, 8(Apr 1978).

When considering the overall increase in heat loss from an enclosure due to the influence of wind speeds in excess of those specified at a particular design condition, it is necessary to examine the relationship between the ventilation and structural losses in order to assess the additional thermal loads imposed. The thermal load imposed by the infiltration of cold outside air into the interior of a heated building is a function of the prevailing wind speed and the difference between the internal and external temperatures, which parameters also affect the rate of heat flow through the building fabric. Consequently, the total heat requirement with a strong wind and a moderate external temperature may be equal to, or exceed, that with a light wind and a lower external temperature. A simplified analysis is given to quantify these factors in terms of their effects upon internal temperatures.

50553 Lebit system. Reinoldsmann, G. (Vereinigte Elektrizitaetswerke Westfalen A.G. (VEW), Dortmund (Germany, F.R.). Abt. fuer Planung und Bau der Fernheizung). *Fernwaerme Int.;* **7**: No. 1, 1-7(Feb 1978). (In German).

In order to clear up the technical problems in the Lebit system a report was drawn up by collaboration between the operators, system construction engineers and operation managers. From this the author gives a report on the first experience gained with the Lebit system and discusses the properties of the material in the Lebit system. He also mentions what weight the committee attached to the Lebit construction and to the possibility of testing the quality standard.

50554 Is one heating installation equal to another. Schmidt, E. *Fernwaerme Int.;* **7**: No. 1, 9-12(Feb 1978). (In German).

The author proposes a classification of heating installations according to their quality, when the term 'quality' is applied to that installation with which waste of energy can be avoided. He indicates the advantages of assessing installations according to their quality for the building contractor, the planner, the installer, the operator and the user. The order of magnitude of the possible energy saving is shown in relation to the quality of the installation.

50555 Return flow as a heat source in a residential area of Heidelberg. Buck, H. (Stadtwerke Heidelberg A.G. (Germany, F.R.)). *Fernwaerme Int.;* **7**: No. 1, 7-9(Feb 1978). (In German).

In the municipal works at Heidelberg the possibility occured of supplying a small residential area via a converter station along from the return flow of an old hotwater system. The author gives a report on this topical measure, which represents inter alia a method of improved energy utilisation.

50556 Heating gives off dosed heat: when low-temperature heating systems are installed, conventional radiators can be used. Reichmann, H.H. *VDI (Ver. Dtsch. Ing.) Nachr.;* **32**: No. 2, 4(Jan 1978). (In German).

The article is concerned with thoughts on the efficient use of heating energy for buildings. The use of solar energy and of heat pumps is also discussed in this context. More economical energy consumption can be reached by using low-temperature heating systems. Designs of systems of this kind are discussed, while taking into consideration the use of conventional radiators. Decisive for the success of a heating system is that it gives off cosy heat. The influence of wall temperature and the distribution of the temperature in the room on cosiness is discussed.

50557 Role of district heating in UK energy conservation. Haseler, E. *Pet. Rev.;* **32**: No. 373, 34-36(Jan 1978).

After briefly defining district heating and showing how it works, the author examines the U.K. potential of district heating and possible energy savings that can be achieved. Energy statistics show that by far the largest sector of U.K. primary fuel consumption is for heating generally, so that the use of waste heat it in towns instead of fuels and electricity will make an immense contribution to energy conservation. 5 refs.

50558 Gas for base load. Saving with the aid of the binary-fuel burner. Maack, J. *PPI;* No. 4, 54-56(Dec 1977). (In German).

Due to economic reasons, gas utility companies are interested in energy output being as regular as possible. They have to impose additional costs on peak power requirements. In this article, the author explains a) two sorts of price regulations for the power supplied by gas utility companies as well as supply contracts which may be suspended and b) gives advice on how to reduce costs for consumers of peak energy.

50559 New ways of improving the output and life of low-pressure discharge lamps. I. Walz, A. (Tech Univ, Berlin, Ger). *Rev. Metall. (Paris);* **29**: No. 12, 498-501(Dec 1977). (In German).

Results of optimization of low-pressure discharge lamps are presented. By using the most recent advances of semiconductor and capacitor technologies (rectifier-multiplier circuits), the efficiency of these lamps can be improved additionally by 30% approximately. Providing fluorescent lamps with robust cold start-oxide-sinter electrodes, which attain low electrode losses of the usual hot helical electrodes during operation, results in approximately a fivefold increase in their service life compared with the standard fluorescent lamps. The source of losses during the operation of fluorescent lamps are examined, and the improvement proposals for raising the lamp efficiency are analyzed and criticized. Operation of fluorescent lamps using dc from network-fed rectifier ballasts is described.

50560 Planning and safety criteria of heat carrier systems with organic media. Baath, H.L. *Waerme;* **83**: No. 6, 92-96(Dec 1977). (In German).

From Technical meeting and technical exhibition of some energy concepts for the industry; Nuernberg, Germany, F.R. (23 - 25 Nov 1977).

On the ENKON conference (Energiekonzepte fuer den Betrieb -energy concepts for operation) held in Nuremberg from November 23rd to November 25th, possible ways of heat supply by steam, hot water, thermal oils, etc. were discussed, along with planning criteria of heat carrier systems and operational experience with heat carrier systems. The papers were the subject of much discussion amongst the participants of the meeting. This summary article tries to give the main points of the papers as well as the often very critical statements made in the discussions.

50561 Throttle valves for district-heating and steam pipelines. Adams, S.F. (Gebrueder Adams Armaturen, Bochum (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 237-238(Oct 1977). (In German).

The design of throttle valves for the district heating and steam industry and long-term tests are reported on.

50562 Ball-cocks as shut-off devices in district-heating pipeline construction. Birwe, H. (Bitter (W.), Bielefeld (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 231(Oct 1977). (In German).

In district heating construction, the use of ball-cocks as the isolating device has made quick progress. The problems of material selection, the sealing of the ball-cock, and the ball bearings are discussed for various designs.

50563 'Autarkon' heat meter. Debbertin, B. (Industrie-Werke Karlsruhe Augsburg A.G., Karlsruhe (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 222-224(Oct 1977). (In German).

The mode of operation and design of the calorimeter 'Autarkon', a heat meter for district water heating, are explained. The calorimeter works mechanics-free and overload-safe. It has proven itself in long-term tests.

50564 Supratherm-flexible insulating materials for district-heating lines laid in the ground. Harders, O. (Elf Bitumenwerk G.m.b.H., Brunsbuettel (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 197(Oct 1977). (In German).

District heating pipelines have to be insulated as well as protected against corrosion. Both requirements are met by the supratherm insulating system. The article describes how the bitumen-cork mixture is made on an industrial scale, and which advantages it has when used on building sites.

50565 Use of the jet pump in district-heating supply systems. Hesselbacher, H. (Baelz und Sohn K.G., Heilbronn (Germany, F.R.)). *Fernwaerme Int.;* **8**: No. 5, 235-236(Oct 1977). (In German).

Jet pumps make efficient use of available pressure energy. The possibilities to use them in hot-water transfer stations between the urban district heating network and the domestic recipients are investigated, and a comparison is made with traditional heat transfer stations as regards their economy.

50566 World's first district heating plant with fluidized bed. Lindberg, P.H. *Fernwaerme Int.;* **6**: No. 5, 253-254(Oct 1977). (In German).

Fluidized-bed combustion plants show concern for the environment, and they are to a high degree independent of the kind of fuel used. In the autumn of 1977, the world's first district heating station on the fluidized-bed principle went into operation in Enkoeping, Sweden. The plant is briefly described, as well as the mode of operation of a fluidized bed with its advantages and disadvantages.

50567 Axial compensator with no problems for district-heating construction. Martiny, U. (Teddington Kompensatoren G.m.b.H., Butzbach (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 215(Oct 1977). (In German).

The article presents a brief description of the axial compensator 'Max Comp', emphasizing its advantages over the traditional axial compensators.

50568 ICM alarm system. Moerch, P. (A/S i.c. Moeller, Fredericia (Danmark)). *Fernwaerme Int.;* **6**: No. 5, 234(Oct 1977). (In German).

The ICM alarm and control system for long-distance mains is described. It not only reports assembly errors but it also records a certain moisture temperature being exceeded.

50569 Pipeline system for the economic connection of single-family houses to a district heating network. Rosenschoeld, M.J. af (Graenges Metallverken, Vaesteras (Sweden)). *Fernwaerme Int.;* **6**: No. 5, 232-233(Oct 1977). (In German).

The Swedish pipeline system 'Aquawarm', with which one-family houses can be connected up to district heating networks in a simple, safe and economic way, is described. It is characterized by good corrosion resistance, a simple expansion offset (sinusoidal pipelaying), long and easy to handle supply lengths, and simple laying of the easily bendable pipes.

50570 Gecos PR cocks for district heating. Riese, E. (Gecos Armaturen G.m.b.H., Bielefeld (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 236-237(Oct 1977). (In German).

The Gecos PR cock is a tap with cyclindrical plug which can be retightened at a later stage. Its construction and properties, as well as the long-term experience with this product are reported on.

50571 Witermo heat container in the service of engineering and economic efficiency of the Scandinavian district-heating supply. Ruecker, C.D. (Witermo Oy, Kaarina (Finland)). *Fernwaerme Int.;* **6**: No. 5, 199-202(Oct 1977). (In German).

The shop-assembled, oil-fired container central heating plants (0.7-8.0 MW) of the big Finnish combine Witermo Oy are described. They can be used especially for district heating and for industrial purposes.

50572 Safety equipment for indirectly heated thermal generators. Vollmer, R. (Braukmann Armaturenfabrik G.m.b.H., Mosbach (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 238-241(Oct 1977). (In German).

Indirectly heated thermal generators (heat exchangers) are used in connection with district heating for indirectly connecting up hot-water heating systems and water heaters. On the basis of valid standards and technical rules, a survey is presented of measures for thermal protection as well as protection of water heaters against excessive pressure. Safety equipment is illustrated by examples.

50573 Domestic hot-water heater combination comprising a heat exchanger and storage system (System D). Hagemann, H. (CTC G.m.b.H., Duesseldorf (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 221-222(Oct 1977). (In German).

System D, a combination of an externally installed heat exchanger as an instantaneous water heater and a carefully adjusted storage system, presents a new kind of domestic water heating. The advantages as against traditional systems, the mode of operation, and the design of System D are presented.

50574 Conduit-free district-heating pipe system based on the G+H Andersen method. Wunsch, H. (Gruenzweig und Hartmann Montage G.m.b.H., Ludwigshafen (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 198-199(Oct 1977). (In German).

According to the G+H-Andersen insulating process, the medium pipe is decoupled from the hard polyurethane foam by a gliding layer. The district heating pipe system, which is laid conduit-free, is described. Comparisons are made with the covered canal.

50575 Preparation of domestic hot water in district-heating systems. Kremer, R. (Froeling G.m.b.H. und Co., Overath (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 206-208(Oct 1977). (In German).

The measures for energy conservation by improved thermal insulation of buildings will lead to a different accent being set in district heating supply. In contrast to the heat requirements for heating, the demand for heat to make hot water will rise. Thus, properly planned water heating will be even more important in the future for the economy of district heating networks. On account of the low temperature level, central water heating offers itself for the improved utilization of district heating water once transported. Design and mode of operation of two-cycle water heaters according to the storage principle and to the circulatory priciple are described. The advantages as regards economy for operators as well as customers are pointed out.

50576 PTFE friction bearings in pipeline construction. Dimpker, W. (IBG Monforts und Reiners G.m.b.H. und Co. K.G., Moenchengladbach (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 209-211(Oct 1977). (In German).

The continual spread of district heating supplies requires safe and easily maintained plant. This applies particularly to the construction of pipe supports. After a short review of well known pipe support constructions such as steel/steel friction bearings, roller bearings and PTFE sheet bearings, the construction, properties and advantages of the newly developed PTFE friction bearings for pipework systems are described.

50577 Hot-water boilers for high outputs. Dressen, K.H. (Dampfkessel und Maschinenbau Ferdinand Lantjes, Duesseldorf (Germany, F.R.). Abt. Waermetechnische Berechnung); Kuemmel, H.J. (Dampfkessel und Maschinenbau Ferdinand Lentjes, Duesseldorf (Germany, F.R.). Projekt-Abteilung Sonderkessel). *Fernwaerme Int.;* **6**: No. 5, 202-205(Oct 1977). (In German).

The flow criteria of hot water boilers (natural circulation, forced circulation, once-through boilers and their combinations) are described. Hot water boilers with natural water circulation are safe in operation in small and medium sizes, even if they are not without problems (for multi-unit plant). Hot water once-through boilers with superimposed forced circulation can be built up to large output units by having stable, sufficient and well defined flow conditions in all load areas. The control range of 10% to 105% is further limited by firing. Problems with parallel operation are non-existent; the boilers can be operated without difficulty alongside hot water generators of other types.

50578 Ageing behavior of PU foams in district-heating pipelines. Second report on the 1977 AGFW conference in Duesseldorf - technical lectures from industry. Eilhardt, B. (Kabel- und Metallwerke Gutehoffnungshuette A.G., Hannover (Germany, F.R.). Abt. Kunststoffe). *Fernwaerme Int.;* **6**: No. 5, 193-194(Oct 1977). (In German).

The life expecatancy of district heating pipelines amounts to 30-50 years and depends, above all, on the ageing behavior of the thermal insulation. PU foams are organic materials, whose ageing is determined to a greater extent by temperature, time and the surrounding medium than is the case for inorganic glass fibers. The report gives the requirements for ageing behavior of PU foams and reports the results of laboratory experiments.

50579 Detection system for external and internal damage to Pan-Isovit district-heating pipelines. Koch, D. (Meier-Schenk G.m.b.H., Speyer (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 194-196(Oct 1977). (In German).

The report introduces methods of measurement for the detection of damp penetration and mechanical damage of Pan-Isovit pipework systems and for the determination of the location of the damage. The detection system, which is independent of flow, permits routine testing of sections of pipe for faults in the insulation or for electrical breakdown. The insulation monitoring equipment

makes a continuous detection of dempness of the whole interconnected network possible from the nearest heating power station. Fault location takes place by 'running time measurement' or using an audio frequency process.

50580 Compensation-free laying fo district-heating pipelines. Kuhlmann, W. (Preussag A.G. Winter Rohrbau, Quakenbrueck (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 208(Oct 1977). (In German).

A pre-stressed steel-in-steel pipe was chosen for the underground laying of an 11 km long pipe line in Switzerland for pumping heavy heating oil at a temperature of 110°C. By pre-stressing the pipes during laying, one should obtain a stress-free condition during operation. A 250 meter long pipe was laid for experimental purposes. Processes for pre-stressing and for fitting the easily flowing insulating material 'Pulvinsul' are described.

50581 Yarway Gun-packed expansion stuffing boxes. Kunze, B. (Deutsche Yarway-Organisation, Duesseldorf (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 211-214(Oct 1977). (In German).

The Yarway gun-packed expansion stuffing boxes for compensating pipeline systems do not have the disadvantages of the ussual expansion stuffing boxes. They are absolutely tight due to the great packing space and never have to be repacked because of non-ageing special packing. They are simple and cheap to instal, safe in operation, not sensitive and save space. The gun-packed expansion stuffing boxes are compared with other means of compensation.

50582 Petroleum emulsion splitter. Oppenlaender, K.; Liebold, G.; Mohr, R.; Buettner, E.; Matschat, K. (to BASF A.G., Ludwigshafen am Rhein (Germany, F.R.)). German(FRG) Patent 2,013,820/C/. 20 May 1976. 7p. (In German).

Emulsion splitters based on oxalkylated compounds and their use as cold splitter for water-in-oil emulsions are described. They contain as effective component 25 - 75 wt.% of an oxethylation and/or Oxpropylation product of an isoalkyl phenol formaldehyde resin with 3 to 30 benzene nuclei all having an oxalkylate group with 4 - 50 alkalene oxide units and, in para position to the oxalte group, a bonded isoalkyl rest (8 - 12 C atoms). As the second effective component the emulsion splitters contain 75 - 25 wt.% of an esterification product of colophonium or a mono, di or tri-ester of the maleopimaric and with oxethylation and/or oxpropylation products of aliphatic polyhydroxy compounds with 2 to 10 C atoms (each having 30 - 150 alkylene oxide units per functional group).

50583 District heat is not always the most economical way of energy supply. Goehringer, P. *HLH, Z. Heiz., Lueftung, Klim., Haustech.;* **27**: No. 11, 417-419(1976). (In German).

From Meeting on possibilities and limits of efficient energy utilization; Bonn, Germany, F.R. (16 - 17 Sep 1976).

Future ways of heat supply by district heating, solar energy, heat recovery, or heat pumps were the main topics of a meeting of the VDI society for technical installations in buildings under the heading 'Possibilities and limits of rational energy supply', held in Bonn on September 16 and 17, 1976. The paper summarizes the main findings of the meeting.

50584 District heat need not be more expensive: results of the district heating studies are introduced. Hoehr, H. (Kraftanlagen A.G., Heidelberg (Germany, F.R.)). *Sanit. - Heizungstech.;* **41**: No. 12, 784-786(1976). (In German).

In the framework of its research activities the Federal Ministry for Research and Technology (BMFT) has initiated five detailed investigations of the possibilities, preconditions and probable success of an enhanced expansion of district heat supply in the Federal Republic of Germany. The present article gives a general survey of these investigations. This summary deals with tasks, heat demand determination, heat generation, heat transport, heat distribution, economy, ecology and economic importance.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 50469

50585 (PB—263883) **Thermal performance of a two-bedroom mobile home. Final report.** Teitsma, G.J.; Peavy, B.A. (Dow Chemical Co., Midland, Mich. (USA); National Bureau of Standards, Washington, D.C. (USA). Center for Building Technology). Jan 1977. 102p. (NBSIR—76-1182). Dep. NTIS, PC A06/MF A01.

Tests were conducted on a mobile home located in an Environmental Climatic Laboratory for the purpose of evaluating its thermal performance. The heating demand greatly affected the part-load efficiency of a gas-fired, forced-air, sealed-combustion furnace system. The practice of installing oversized heating plants was shown to result in low seasonal operating efficiencies. Air leakage measurements were performed using a pressurization technique to quantify the amount of air leakage through the various parts of the mobile home. Separate air infiltration tests using the SF_6 tracer-gas technique showed that somewhat higher air infiltration rates were induced by operation of the mobile home heating plant. A thermographic survey of interior surfaces showed that the technique used to install the wall insulation may allow wrinkles formed in the surface of the insulation to form air paths running the height of the wall cavity. Convective air flow through these paths may create heat leaks on the building surface which can have an impact on the overall heat-loss rate. Separate tests were also conducted to identify places in the mobile home envelope having high condensation potential.

50586 Economic use of energy in housing construction. model simulations, planning aids. Christensen, S. (Stuttgart Univ, Ger). *Fortschr.-Ber. VDI Z., Reihe 4;* No. 38, 1-138(Jan 1978). (In German).

A wide variety of measures, ranging from improvements in heat insulation to the installation of solar collectors, are investigated by means of which energy can be saved in multistory housing construction. In order to implement these improvements in practice, the economic advantage of each measure must be recognizable. This, however, must be considered over the entire lifetime of the housing. With the aid of investment calculus the revenues resulting from saved heating energy and the expenses for increased heat insulation are compared, the capital return and the amortization of the additionally invested capital are determined, and a study is made of the financing of the additional investment for new construction and for the modernization of old buildings. In certain particular cases it is shown that possibilities ranging from improvements in planning to more effective use of equipment exist for decreasing the energy requirements of multistory residential buildings.

50587 How high are the costs to invest for thermal insulation of buildings and for determination of heat consumption in dwellings in district heated buildings. Dommann, D. (Hamburgische Electricitaets-Werke A.G. (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 6, 263-272(Dec 1977). (In German).

Thermal insulation and heat measurements need additional investment, which is only justified, if it can be financed by compensating the costs of heating. Where the limits are, until this additional investment appears economic, is to be shown.

50588 Temperature-related adjustment and heat-cost distribution in multi-family houses. Bornstein, J. (SWM Waermezaehler G.m.b.H., Hamburg (Germany, F.R.)). *Fernwaerme Int.;* **6**: No. 5, 224-226(Oct 1977). (In German).

The possibilities of saving energy in existing buildings are shown. Energy saving in space heating can be achieved very simply by reducing the room temperature or very cost-effectively by setting the heating system, i.e. by levelling the temperature differences between flats of a block of flats for the same external conditions. In a Swedish research project, a reduction of heat consumption by 40% could be achieved by both these measures. In order to be able to carry out a correct heating cost distribution, the 'Central heating meter SVMC-70' made by SVM heat meters GmbH is recommended, which measures the temperatures in individual rooms of a flat continuously and gives the degree-day figures for each flat.

50589 'Tritherm' experimental house in operation. Junkers' experimental plant with new solutions. *Kaelte Klimatech.;* **30**: No. 10, 424, 426, 429(1977). (In German).

3 heat sources are used in the heating plant of the 'Tritherm' experimental house, which was recently completed: solar energy, external air and conventional fuels. Radiators or, alternatively, hot water underfloor heating was used for heating purposes. The individual plant of this system (solar plant, heat pump, additional heating, hot water boiler, energy store, control, water and heat recovery plant) are described, which gives the opportunity of obtaining interesting results in practice.

50590 Method to produce a heat exchanger, and heat exchanger produced accordingly. Maisonneuve, M. (to Promothermo Verwarmingstoepassing B.V., Amsterdam (Netherlands)). German(FRG) Patent 2,552,348/A/. 12 Aug 1976. 13p. (In German).

The method consists in the attachment of fins by means of a press fit. For this purpose, the fins get borings which are somewhat smaller than the outside diameter of the tubes. A tube is pressed into the fins by means of a conical pin inserted into its boring whereby a small flonge is formed, supporting the press fit. If several fins are to be pressed on at fixed distances, they are inserted into a device retaining the fins unremovably and non-workably. Now the tube with the pin inserted is punched through all fins in a single pass. Two or more parallel tubes may be pressed in the same way by means of combined fins containing in each case two or more borings. For further safety of the press fit of fins onto the tubes, a plastic coating is provided. For improving thermal conductivity, aluminium, graphite or zinc powder is to be added to this material.

50591 Home heating conservation alternatives and the solar collector industry. Magnas, H.; Stoll, R.; Walton, H. *Mon. Energy Rev.;* 2-9(Mar 1976).

This article discusses analyses of 20-year costs for retrofitting single family residences with increased amounts of insulation and solar energy systems. The results of this study indicate that the heating load of the "average" single family dwelling with 2 ½ inches of ceiling insulation can be reduced up to approximately 35% by (1) adding enough ceiling insulation to equal 10 to 12 inches and (2) installing storm windows and doors. This is for a home in an area with solar radiation characteristics similar to those of Washington, D.C. Twenty-year life cycle cost analyses show that water and space heating via solar collector systems compete favorably with conventional electrical heating systems, but not with conventional gas or oil heating systems except in regions of the country where there are extremely high fossil fuel prices. If solar collectors were mass produced, the competitive advantage might increase because of reduction in costs. The level of manufacturing activity in the solar collector industry, based on FEA surveys, is also discussed in this report. There are indications of a 400% increase in the production of medium-temperature flat plate solar collectors during 1975. Continued rapid expansion will have to occur before solar collectors will have an appreciable impact on the country's total consumption of fossil fuels.

OFFICE BUILDINGS

50592 (LBL—7825) High performance solar control office windows. King, W.J. (Kinetic Coatings, Inc., Burlington, Mass. (USA)). Dec 1977. Contract W-7405-ENG-48. 120p. Dep. NTIS, PC A06/MF A01.

Investigations conducted over a 9 month period on the use of ion beam sputtering methods for the fabrication of solar control windows for energy conservation are described. Principal emphasis was placed on colored, reflecting, heat rejecting, office building windows for reducing air conditioning loads and to aid in the design of energy conserving buildings. The coating techniques were developed primarily for use with conventional absorbing plate glass such as PPG solarbronze, but were also demonstrated on plastic substrates for retrofit applications. Extensive material investigations were conducted to determine the optimum obtainable characteristics, with associated weathering studies as appropriate aimed at achieving a 20 year minimum life. Conservative estimates indicate that successful commercialization of the windows developed under this program would result in energy savings of 16,000,000 barrels of oil/year by 1990 if installation were only 10 percent of new commercial building stock. These estimates are relative to existing design for energy conserving windows. Installation in a greater percentage of new stock and for retrofit applications could lead to proportionately greater energy savings. All such installations are projected as cost effective as well as energy effective. A secondary program was carried out to modify the techniques to yield thermal control windows for residential applications. These windows were designed to provide a high heat retention capability without seriously affecting their transmission of incident solar radiation, thereby enhancing the greenhouse effect. This part of the program was successful in producing a window form which could be interchanged for standard residential window material in a cost and energy effective manner. The only variation from standard stock in appearance is a very light rose or neutral gray coloring.

50593 Influence of internal environmental design conditions and fresh air quantity on system load and energy consumption in air conditioning systems. Boelema, T.; Kerens, G. (NMERI, CSIR, Pretoria, S Afr). *S. Afr. Mech. Eng.;* **28**: No. 1, 12-17(Jan 1978).

Preliminary results of comfort tests carried out by the National Mechanical Engineering Research Institute indicate that the comfort preference of South Africans, at least on the highveld, falls within the comfort envelope of the ASHRAE Chart. Attention should be paid to the fresh air quantity aspect of any specific designs, because even though too liberal use of fresh air can result in a considerable waste of energy from too conservative an estimate, reducing the design capacity of a system may, under certain climatic conditions, result in no energy savings taken over a one year period.

50594 Impact of energy and capital conservation on air conditioning systems. Spoormaker, H.J. (Ove Arup and Partners). *S. Afr. Mech. Eng.;* **28**: No. 1, 27-36(Jan 1978).

To achieve reduction in energy consumption and increased economic life and reliability of air conditioning systems it is necessary to recognise the importance of 'human factor' design to improve the quality of operation, servicing and maintenance. There is a tendency to either squander capital on sophisticated building automation systems, or to operate and service the installations without the correct number of qualified operating and servicing staff. South Africa has a large pool of trainable operating and service staff and training is relatively inexpensive compared to the extra capital expenditure and annual energy cost caused by the lack of this training.

TRANSPORTATION

50595 Deregulating transportation: tracking the progress. Moore, T.G. *Regulation;* **2**: No. 2, 37-44(1978).

Based on a paper presented at the AEI conference on regulation and regulatory reform, December 19, 1977.

Optimism for changes in regulation of the transportation sector is seen in recent deregulation of the air cargo and railroad industries and the anticipated relaxation of airlines and trucking. Congress passed a 1977 bill opening the air cargo industry to all carriers and expanding the discretion allowed operators on routes and charges. While this represents a large change for a small industry, it does demonstrate the public benefits of a free market. The Railroad Revitalization and Regulatory Reform Act of 1976, on the other hand, is a minor adjustment setting new standards for railroad rates to encourage competitive pricing and making it more difficult for a company to abandon lines. Its success will encourage legislators to address air passenger service. A review of past and current airline deregulation efforts concludes that enough support has developed for at least partial success. Deregulation of the trucking industries seems less likely, no proposals now being before Congress. The progress made to date is credited to the persistent and thorough efforts of economists and scholars.

50596 Energy savings consequences of better urban public transport. Means applicable in the short term. Renchon, R. (Ec Super d'Electr, Paris, Fr). *Rev. Soc. R. Belge Ing. Ind.;* No. 3, 91-102(Jul-Aug 1977). (In French).

A study is made of the means by which the surface public transport network of Brussels can be made more efficient and, in particular, more attractive to travelers able to choose between this network and their private cars. In this connection a strategy of modest cost is developed for quickly achieving greater use of the public transport network by eliminating factors causing slowness and irregularity in the running of streetcars and buses primarily through measures giving priority to those vehicles over private cars. 8 refs.

RAILWAY

REFER ALSO TO CITATION(S) 50410, 50520

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 50410

50597 Rolling resistance of wheels with pneumatic tires. Vodyanik, I.I. *Izv. Vyssh. Uchebn. Zaved., Mashinostr.;* No. 10, 115-118(1977). (In Russian).

Based on rheological models of deformation of a tire and the soil, as well as on a scheme of interaction between them, an analytical expression is obtained for the resistance, giving results that are close to the experimental data. 9 refs.

PIPELINE

50598 Most economical insulating thickness of pipelines and devices. Koch, K.H. (Kaefer Isoliertechnik G.m.b.H. und Co. K.G., Bremen (Germany, F.R.)). *Oel;* **15**: No. 11, 305-311(Nov 1977). (In German).

If the question of economy is in the fore, then the most economical insulating thickness is to be determined when designing thermal insulation. The most economical thickness is characterized by the annual amortization and operating costs of the component insulated being at a minimum. The factors influencing the most economical insulating thickness and the appropirate calculation, as well as the effects changing boundary conditions have on the insulating thickness are presented.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 50414, 50463, 50464, 50465, 50618

50599 (CONF-761156—, pp 15-23) Study of energy use and energy conservation modifications in the Georgia poultry industry. Lowry, J.F.; Combes, R.S. (Georgia Inst. of Tech., Atlanta). 1976.

From Proceedings on use of solar energy for poultry and live stock production; Auburn, AL, USA (9 Nov 1976).

In Proceedings of symposium on use of solar energy for poultry and livestock production.

An audit of the energy used in the Georgia Poultry Industry is reported. To conduct the survey the industry was divided into five segments: egg processing, broiler processing, feed mills, hatcheries, and broiler producers. All transportation associated energy is excluded. Of the total, 40 percent was consumed by broiler processors, 32 percent by broiler producers, and 21 percent by feed mills. The study was expanded to include recommendations as to methods that should be considered for conserving energy in the industry. (MHR)

50600 (COO—4289-6) **Development of an industry-government cooperative energy-conservation program: Phase II. Project 8993 monthly status report, February 1—February 28, 1978.** Fejer, M.E.; Marnell, C.J. (Institute of Gas Technology, Chicago, Ill. (USA)). Mar 1978. Contract EC-77-C-02-4289. 15p. Dep. NTIS, PC A02/MF A01.

The ultimate objective of this program is to determine the industrial energy conservation measures for small manufacturers that are practical, specific, rapidly implementable, and cost effective. The approach being taken is one in which the trade associations representing the various small manufacturers agree to cooperate in providing the necessary contacts and data for evaluating their respective industries. The data are to be collected by monitoring the performance of several pieces of energy-consuming production equipment within two industries selected for this purpose, namely, the diecasting industry and the metal heat-treating industry. Currently, data are being collected.

50601 (NP—23143) **Forest industries energy research: summary. Report No. 12.** Scott, G.C. (Beca, Carter, Hollings and Ferner Ltd., Auckland (New Zealand)). Oct 1976. 41p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The forest industries of New Zealand contribute 10% of that country's factory production and consume 25% of all industrial energy. A study was begun in 1975 to determine the energy used in each of the 19 major production processes in the New Zealand forest industries, the energy conservation possibilities in these processes, and the effects of fuel substitutions including waste usage on the industry and on individual plants. Policy regulations, economic incentives, and environmental issues are considered. Recommendations for improving the energy efficiency of the forest industries include greater use of wood wastes for process heat and power generation; recycling of paper, especially newsprint; development of more natural gas pipelines to serve wood industry; modernization of plant equipment; in-plant power generation; and increased emphasis on using geothermal steam for process heat and electric power. (LCL)

ENERGY SOURCES

50602 More sun, less natural oil for lettuce and roses. Energy saving for greenhouse cultivation in intensive gardening. Timmermann, F. (Goettingen Univ. (Germany, F.R.). Inst. fuer Agrikulturchemie). *Umsch. Wiss. Tech.;* **78**: No. 3, 68-95(Feb 1978). (In German).

The article is a report on a meeting held in August 1977 on 'More profitable use of energy in protected cultivation' of the Society of Horticulture and the Swedish University of Agricultural Science. The processes discussed can be arranged in the following groups: 1) More effective heat insulation by improved insulation techniques 2) Energy saving by purposeful control of growth factor temperature, lighting and CO_2 supply suitable to the plants requirements 3) Greater use of solar power 4) Greatest possible use of waste heat from power stations, industrial processes and waste materials.

50603 Extension of the possibilities of utilization of fuels by addition of oxygen. Bonnekamp, H.; Hoffmann, G.W.; Seeger, M. *Stahl Eisen;* **98**: No. 4, 141-149(Feb 1978). (In German).

From Ironworks day; Duesseldorf, Germany, F.R. (10 - 11 Nov 1977).

With a view to extending the possibilities of utilization of pure blast furnace gas for the thermal processes of the iron and steel industry as for instance for firing coke oven batteries, sintering plants, hot-blast stoves, and also heating and heat-treating furnaces, rich gas is actually added to the blast furnace gas or the gas and the combustion air are preheated. These two methods are compared with another method for extending the limits of utilization of blast furnace gas by enrichment of the combustion air with oxygen, and the thermal and energy-economic effects on the two groups mentioned are investigated using examples of thermal processes.

50604 Possibilities and limits of maximum control of electric power in an integrated iron and steel work. Nagel, F.J. *Stahl Eisen;* **98**: No. 4, 149-157(Feb 1978). (In German).

From Ironworks day; Duesseldorf, Germany, F.R. (10 - 11 Nov 1977).

Various consumers can be put out of operation depending on their suitability and the type of their power input in order to lower the cost of electric power in the main load periods by reduction of the input maximum: for instance rolling mills, arc furnaces. This can be done with the aid of a family of characteristics which is based on the maximum amount of work in the accounting period, the maximum possible power, and the minimum power. Decisive for putting rolling mills out of operation is their current consumption. It has been determined for different steel grades as a function of the rolling temperature. Finally, efficient maximum control is suggested for an iron and steel works, and relevant mistakes are discussed.

50605 Recent developments in the iron and steel industry in the light of energy conservation. Sinha, U.K. *Steel Times;* **206**: No. 1, 61-71(Jan 1978).

Recent developments in the production of coke, pig iron steel are described. By the use of methods such as pipeline charging, dry quenching, etc., the energy consumption can be reduced. Processes discussed include production of formed coke, dry quenching, and injection of coal into blast furnaces.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 50421

50606 (HCP/M8295—01) **Test and evaluation of the Cravens Wanlass modification for selected single phase fractional horsepower motors.** Cooper, T.D. (Army Mobility Equipment Research and Development Command, Fort Belvoir, Va. (USA)). May 1978. Contract EC-77-A-01-8295. 179p. Dep. NTIS, PC A09/MF A01.

Tests are reported of four single phase, fractional horsepower motors before and after modification in accordance with principles established by the Cravens Wanlass Corporation to effect improvements in energy efficiency. It compares motor characteristics before and after modification, and concludes that the change does, in fact, improve energy efficiency of the motors tested, but at the cost of degrading breakdown torque, avoidable only by introducing additional components. It concludes that the Wanlass modification may be employed to effect worthwhile energy savings, but that each application must be examined on a case by case basis from the standpoints of performance and economics.

50607 Switching off the light is just the start of energy conservation. Beatson, C. *Engineer (London);* **246**: No. 6367, 36-38(6 Apr 1978).

The implementation of energy conservation programs at 3M Company plants in the UK is discussed. Many energy conservation measures were cost-free involving merely changes in lighting or heating procedures. Other measures involved modifications to equipment and were selected on a cost effective basis, with an average payback period of 4 months. (LCL)

50608 Is your plant efficient. Milne, J. *Heat. Vent. Eng.;* **52**: No. 607, 10-11(Apr 1978).

Energy waste in boilers is discussed: waste of the fuel being consumed in the boiler plant; and waste of steam, or hot water, after it has been produced. Whatever form this takes it can mean a serious loss of boiler capacity: for instance a fall in combustion efficiency from, say a design efficiency of 80 to 65% means a loss of 18.75% in boiler output--almost one-fifth of design capacity. Usually it must be compensated for, either by forcing the plant or by bringing additional boilers onto line. Very often combustion efficiencies have not been taken for some years and very often, if they are taken, either no corrective action is instigated or any corrective action which has been taken is allowed to lapse with attendant losses in output, fuel and cash. Unlagged steam pipes, boiler tube maintenance, firing periods, and dirty flueways are considered.

50609 Evaluation of power and steam generating alternatives in Kraft mills. Baldus, R.F.; Edwards, L.L. (Univ of Idaho, Moscow). *TAPPI Alkaline Pulp. Conf. Prepr.;* 63-65(1977).

The energy available for steam/power production from the recovery boilers of an existing linerboard mill for two different digester yields forms the basis for this paper. The modular simulation system GEMS allows evaluation of a power cycle for these two alternatives. The same approach is used to compare Kraft furnaces operating at various output steam pressures. Details of the system and its operations are given along with results of its application.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 49808, 49961, 50458, 50607

50610 Yield and utilization of the residual energy in rolling mills and further-processing works. Klammer, H. *Stahl Eisen;* **98**: No. 4, 134-141(Feb 1978). (In German).

From Ironworks day; Duesseldorf, Germany, F.R. (10 - 11 Nov 1977).

Possibilities have been investigated to utilize the thermal losses to the ambiance of heating and heat-treating furnaces in the

iron and steel industry of the Federal Republic of Germany. This study deals with the sensible residual energy bound to waste gas or cooling water of the mentioned industrial furnaces in the further processing works. The evaluation of type, amount, temperature level, and availability of the residual energy allows to draw conclusions on the conditions of the yield of residual energy of all furnaces of the further processing works of the steel industry. The investigation reveals that about 55.7 million GJ per year of the furnaces are discharged non-utilized to the atmosphere, from which about 17.6 million GJ could be still technically utilized under certain conditions for instance for production of hot water and also heating purposes in municipalities. Several factors as for instance life expectancy of the plant, utilization, constructional features, possibilities of utilization of the recuperated heat or also the distance to the cosumer have to be taken into account for assessment.

50611 L.D. steel mill recovery boiler corrosion. Gorsaro, I. (Italsider, Italy). *Termotecnica (Milan);* **32**: No. 1, 26-30(Jan 1978). (In Italian).

After a brief restatement of the thermal fatigue features and its consequences on tube changes, a report is given on an experimental investigation to determine causes and to work out a maintenance program to avoid unexpected breakdowns.

50612 Waste heat utilisation in industrial processes. Weichsel, M.; Heitmann W. *Tech. Mitt.;* **70**: No. 5, 259-272(May 1977). (In German).

A discussion is given of energy cycles and branchings in industrial high-temperature and low-temperature processes with examples of plant technology and economy: waste-heat steam generators connected in series with gas turbines, recuperative and regenerative heat exchangers, heat pumps connected in series with heat treatment furnaces, induction furnaces, and process plants.

50613 Method of recovering the heat of combustion of pyrite in fluidized bed furnaces with the aid of air turbines. Ternovskaya, A.N.; Vasil'ev, B.T.; Egorkina, A.A.; Epifanov, V.M.; Loseva, N.V.; Golod, L.A. *Khim. Prom-st. (Moscow);* No. 12, 34-37(1977). (In Russian).

A new method of recovering the heat of combustion of pyrite in sulfuric acid production, using air turbines instead of steam turbines, is proposed. The heat generated in fluidized bed furnaces is transmitted to compressed air fed into the cooling elements of the furnace and into a heat exchanger outside the furnace, and is used to produce electric energy in an air turbine. It is shown that the use of air turbines reduces the capital expenditures and the need for maintenance personnel, and increases the thermoelectric coefficient of utilization of the excess heat of the process.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 49428

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 50430, 50457, 50503

50614 Estimation of heat losses in system of hot water supply to microdistricts. Zinger, N.M.; Burd, A.L. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 12, 40-42(1978).

Translated from Teploenergetika; 24: No. 12, 53-55(1977).

In closed heat supply systems, residential microdistricts obtain heat from group substations (GS) by a four-pipe heating network: two pipes for the space heating system and two pipes for the hot water supply system. The return (circulation) pipe of the hot water supply system is intended for circulating the water heated in the heaters and for maintaining at all points of water draw-off a water temperature of at least specified value. The nonexistence of circulation leads at a small water draw-off to considerable fall in water temperature in the hot water supply network owing to heat losses and to useless discharge of cooled-off water. The influence of heat losses in the system of hot water supply on the operational mode of a group substation is examined.

50615 Grid connection of an integrated community energy system. Holtz, R.E. (Argonne National Lab., IL). *Energy Convers.;* **17**: 41-44(1977).

This paper describes the possible modes of operation for a grid-connected integrated community energy system. It is seen that this operating mode influences both the design and the operating rules of the system. Also, it is shown that it is essential to examine the overall energy savings to the community, not just the efficiency at which the energy system is operating.

CONSERVATION SERVICES

REFER ALSO TO CITATION(S) 50550

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 49524, 50459, 50518, 50551, 50618

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 50426, 50866

50616 (PNL—2665) **Assessment of powdered activated carbon addition to anaerobic digesters at Salt Lake City, Utah.** Ahlstrom, S.B.; Spencer, R.R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1978. Contract EY-76-C-06-1830. 30p. Dep. NTIS, PC A03/MF A01.

The Salt Lake City Water Reclamation Plant has added powdered activated carbon to its influent wastewater since January 1977. Battelle Pacific Northwest Laboratory has gathered and analyzed operational data from the treatment plant in an effort to identify beneficial effects of the carbon. Benefits occurring during anaerobic digestion were of principal interest. Three potential areas of enhanced treatment were investigated: reduced solids in the primary clarifier effluent; increased anaerobic digester gas production; and increased sludge stabilization rate. Review of the data from the Salt Lake City plant indicates that carbon did not significantly affect these aspects of the plant operation. However, the carbon dose rate was generally lower than that used in other carbon addition studies. Therefore, data from Salt Lake City can be interpreted to mean only that carbon does not produce the above benefits at low doses. Potential benefits identified by other investigators using higher carbon dose rates have not been invalidated.

50617 Process for cooling waste water. Rohner, P. (to Kabel- und Metallwerke Gutehoffnungshuette A.G., Hannover (Germany, F.R.)). German(FRG) Patent 2,524,961/A/. 16 Dec 1976. 9p. (In German).

The process for avoiding thermal pollution of waters described rests on the principle of the heat conduction tube, by which heat is conducted from the liquid space into the atmosphere at a lower temperature above it. Such a tube, here called a cooling tube, consists in its simplest form of a heat conducting corrugated tube, made, for example, of copper or a copper alloy or of precious metals, which is sealed to be airtight at both ends, and after evacuation, is partially filled with a medium of low boiling point. The longer leg of the tube, which is bent at right angles, lies close below the surface of the water to be cooled and parallel to it; the shorter leg projects vertically into the atmosphere. The liquid inside the cooling tube fills the horizontal part of the tube to about halfway. A certain part of the liquid is always evaporated in this part. The vapor rising in the vertical part of the tube condenses on the internal wall cooled by the air outside, and gives off its heat to the atmosphere. The condensed medium flows back down the vertical internal wall into the initial position in a continuous cycle. A further development contains a smooth plastic inner tube in an outer corrugated tube, which is shorter than the outer tube; it ends at a distance from the caps sealing the outer tube at both ends. In this design the angle between the vertical and horizontal leg is less than 90°. The shorter leg projects vertically from the water surface, below which the longer leg rises slightly from the knee of tube. The quantity of the liquid is gauged as a type of siphon, so that the space between the outer and inner tube at the knee of the tube remains closed by the liquid medium. The medium evaporated from the surface in the long leg of the tube therefore flows over the inner tube, which starts above the level of the medium. Thus evaporation and condensation paths are separated.

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 50461

50618 (NP—23224) **Office of Conservation: 1977 annual report.** (Seattle City Light, Wash. (USA). Dept. of Lighting Conservation). 1978. 117p. Seattle City Light, WA.

In October 1977, the Department of Energy awarded Seattle City Light a first-year $375,641 grant to begin a 5-yr. program for promoting and implementing reduced electric power consumption among the utility's residential, commercial, and industrial customers. Activities in this program for the last quarter of 1977 are detailed. (LCL)

50619 (TID—28606) **Energy conservation for municipal officials and managers. Participant's notebook.** (Local Government Research

Corp., State College, Pa. (USA)). 1978. 161p. Dep. NTIS, PC A08/MF A01.

The Pennsylvania Energy Extension Service held a number of two-day energy conservation seminars across the state for local government officials. This workbook was prepared to assist the seminar participants in following the material being presented and to be used for making notes for later reference. The topics discussed at the seminar included energy audits, evaluating capital investments and conducting cost analyses, community awareness, energy considerations in code enforcement, and energy conservation in new and existing building, vehicle operation and maintenance, road design and maintenance, and outdoor lighting. (JSR)

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

SPARK-IGNITION

REFER ALSO TO CITATION(S) 50633, 50637, 50639, 50645

50620 (COO—4493-1) **Improving the performance and fuel consumption of a dual-chamber stratified charge spark ignition engine. Progress report, September 1, 1977—November 30, 1977.** Sorenson, S.C. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 28 Feb 1978. Contract EC-77-S-02-4493. 7p. Dep. NTIS, PC A02/MF A01.

Improvements were made in the combustion chamber geometry of the combustion model. Studies conducted with different spatial intervals in the combustion model have indicated problems with mass conservation depending on spatial step size. Work was initiated on a gas dynamic model for the prechamber intake system. Development of high speed motion picture techniques is continuing, and a new fuel system for the main chamber intake port is being developed.

50621 (COO—4493-2) **Improving the performance and fuel consumption of a dual-chamber stratified charge spark ignition engine. Progress report, December 1, 1977—February 28, 1978.** Sorenson, S.C. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 28 Feb 1978. Contract EC-77-S-02-4493. 17p. Dep. NTIS, PC A02/MF A01.

An improved model for the connecting nozzle between the prechamber and main chamber has resulted in the solution of mass conservation and spatial step size dependencey problems. The qualitative nature of the flow out of the prechamber is also in better agreement with the results of the photographic investigations. Effects of ignition location on the rate of combustion were investigated with the combustion model. Work on the intake gas dynamic model for the prechamber intake system was temporarily discontinued. The use of fuel additives has increased the luminosity of lean flames enabling increased quality of high speed motion pictures at engine speeds up to 1700 rpm. A new main chamber fuel injection system is being installed in order to increase accuracy of fuel air ratio measurements.

50622 (DOT-TSC-NHTSA—78-2) **Performance characteristics of automotive engines in the United States. Second series. Report No. 1, 1976 Chevrolet Vega 140 CID (2.3 liters), 2V.** Chamberlain, T.W.; Koehler, D.E.; Stamper, K.R.; Marshall, W.F. (Department of Energy, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Apr 1978. Contract EC-76-A-31-1012. 61p. (HS—803-275). Dep. NTIS, PC A04/MF A01.

Experimental data were obtained in dynamometer tests of a 1976 Chevrolet Vega 2.3-liter, 140-CID engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine-performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

50623 (DOT-TSC-NHTSA—78-3) **Performance characteristics of automotive engines in the United States. Second Series, Report No. 2: 1976 Chevrolet, 305 CID (5.0 liters), 2V. Interim report.** Chamberlain, T.W.; Koehler, D.E.; Stamper, K.R.; Marshall, W.F. (Department of Energy, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Apr 1978. Contract EC-76-A-31-1012. 60p. (HS—803-276). Dep. NTIS, PC A04/MF A01.

Experimental data were obtained in dynamometer tests of a 1976 Chevrolet 305-CID V-8 engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine-performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

50624 (DOT-TSC-NHTSA—78-6) **Performance characteristics of automotive engines in the United States. First series. Report No. 13. 1975 American Motors, 258 CID (4.2 liters), 1V.** Marshall, W.F.; Stamper, K.R. (Department of Energy, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Apr 1978. Contract EC-76-A-31-1012. 36p. (HS—803-279). Dep. NTIS, PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 AMC 258-CID production IV engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine-performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

50625 **Abnormal wear of exhaust valve seat under use of lead-free gasoline.** Furuhama, S.; Hiruma, M. (Musashi Inst. of Tech., Tokyo (Japan)). *Nippon Kikai Gakkai Rombunshu;* **43**: No. 369, 1889-1908(May 1977). (In Japanese).

The large problem in the use of lead-free gasoline is valve recession, in which the wear of an exhaust valve seat made of cast iron becomes large when lead-free gasoline is used, and the gas tightness is impaired, but its mechanism has been unknown. The authors have carried out the continuous measurement of wear with radioisotopes in order to solve this problem. As most of wear chips are mixed in condensed water, the measurement of wear can be carried out by the measurement of radioactivity in condensed water. As for the movement of a valve, besides the rotation, sidewise oscillation occurs violently. The making of a radioactive exhaust valve seat, the collection of wear chips, the collection efficiency of a filter, the measurement of the attenuation of radioactivity, the measurement of the rotation and sidewise oscillation of an exhaust valve, and the experimental engine used are explained. The cast iron of the valve seat is deposited on the seating face of the exhaust valve, and it shaves the valve seat owing to the rotation and sidewise oscillation of the exhaust valve. The wear increased rapidly in highrevolution and high load operation. The rotation and sidewise oscillation of the exhaust valve were intensified by high revolution. The effect of exhaust temperature was not large.

50626 **Heat exchanger.** (to Cheminees Richard le Droff S.A., 91 - Yerres (France)). German(FRG) Patent 2,521,444/A/. 27 Nov 1975. 6p. (In German).

The invention deals with the improved utilization of the heat contents of flue gases, e.g. of an indoor fire-place. For this purpose, a simple heat exchanger of the following design is proposed: A metal discharge tube of, e.g., square cross section is enclosed by a jacket with a larger square cross section and with two apertures for the inlet and outlet of air. The space between discharge tube and jacket is closed tightly by horizontal surfaces at the top and at the bottom. It contains 'fragmentary' conducting material, e.g. scobs made of Cu or Al. A fan absorbs or presses cool outside or ambient air through the jacket space as a heat exchanger. The heat of the flue gas is passed on onto the air flow via the sides of the discharge tube and the scobs. The heated air is effectively released into the room.

DIESEL

50627 (DOT-TSC-NHTSA—78-5) **Performance characteristics of automotive engines in the United states. First series. Report No. 12. 1975 Perkins Diesel 247 CID (4.0 liters), F. I.** Marshall, W.F.; Stamper, K.R. (Department of Energy, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Apr 1978. Contract EC-76-A-31-1012. 36p. (HS—803-278). Dep. NTIS, PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 Perkins 247-CID diesel engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine-performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

TURBINE

REFER ALSO TO CITATION(S) 50643

50628 (COO—2637-1) **Process demonstration and cost analysis of a mass production forging technique for automotive turbine wheels:**

Phase II. Final report, January 1975—March 1977. Allen, M.M.; Larson, K.J.; Walker, B.H. (Pratt and Whitney Aircraft Group, West Palm Beach, Fla. (USA). Government Products Div.). Jul 1977. Contract EY-76-C-02-2637. 83p. Dep. NTIS, PC A05/MF A01.

Low cost fabrication of integrally-bladed automotive turbine wheels utilizing the GATORIZING forging process was demonstrated. The capability of the forging process was characterized as to blade shape, and the effect of the blade shape on Chrysler baseline engine turbine efficiency was analytically defined. Actual baseline engine turbine wheels were fabricated from IN100 and AF2-1DA for evaluation. A mass production cost estimate was generated for manufacturing large production quantities.

ROTARY

REFER ALSO TO CITATION(S) 50640, 50641

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 50360, 50367, 50384, 50633

50629 (JPRS—71216) **Translations on Eastern Europe. Scientific affairs No. 586.** 1 Jun 1978. Translation of various papers. 27p. NTIS.

A separate abstract was prepared for one paper on electric trucks. The remaining papers were not in scope for the data base. (RCK)

50630 (JPRS—71216, pp 8-18) **Specifications of new electric trucks published.** 1 Jun 1978. Translated from Voenna Tekh.; No. 11, 17(1977).

In Translations on Eastern Europe. Scientific affairs No. 586.

A description is given of two electric trucks designed to transport freight under urban conditions. The chassis is a welded steel structure with built-in stabilizer. The cab and body are made of fiberglass-reinforced plastic. The cab provides excellent vision and working conditions for the driver.

50631 Supply parts for ac vehicles with self-commutated three-phase current drive. Dreimann, K.; Ciessow, G. *Elektr. Bahnen;* **48**: No. 4, 90-94(1977). (In German).

For the supply of three-phase motors from single-phase-alternating current mains, conversion systems with impressed current or with impressed voltage can be operated in the intermediate circle. The effects of several main parts of systems with impressed current are described. Description is also made of mains-led current converters with section control and self-commutated pulsable current converters with sinusoidal current control.

50632 Three-phase current drive for ac vehicles. Loessel, W. *Elektr. Bahnen;* **48**: No. 4, 82-90(1977). (In German).

The applicability of phase sequency converters in connection with different mains-connected current converters for supplying three-phase-current-motors on rail vehicles is dealt with. Besides evaluating the different mains parts for use in three-phase-current-driven vehicles the author deals with the control and dynamic behavior of the asynchronous motor.

HYBRID SYSTEMS

50633 (CONS—1011-14) **Baseline tests of the Kordesch hybrid passenger vehicle.** Soltis, R.F.; Bozek, J.M.; Denington, R.J.; Dustin, M.O. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jun 1978. Contract EX-76-A-31-1011. 68p. (NASA-TM—73769). Dep. NTIS, PC A04/MF A01.

The Kordesch hybrid passenger vehicle is propelled by an electric motor that receives its energy from a spark-ignition-engine-driven alternator and an electric battery system. It was tested at the Transportation Research Center of Ohio Test Track, East Liberty, Ohio, between August 17 and September 22, 1977. The tests are part of an Energy Research and Development Administration (ERDA) project to assess the state-of-the-art of electric and hybrid vehicles. The Kordesch hybrid vehicle performance test results are presented. The Kordesch hybrid is a four-passenger Austin A40 sedan that has been converted to a heat-engine-alternator- and battery-powered hybrid. It is propelled by a conventional, gasoline-fueled, heat-engine-driven alternator and a traction battery pack powering a series-wound, 7.5-kilowatt (10-hp) direct-current electric drive motor. The 12-kilowatt (16-hp) gasoline engine drives the 7-kilowatt alternator, which provides electrical power to the drive motor or to the 96-volt traction battery through a rectifier. The propulsion battery consists of eight 12-volt batteries connected in series. The electric motor is coupled to a four-speed standard Austin transmission, which drives the rear wheels. Power to the motor is controlled by a three-step foot throttle, which actuates relays that control armature current and field excitation. Conventional hydraulic brakes are used. There is no regenerative braking.

50634 Driving unit for vehicles. Eggmann, E. German(FRG) Patent 2,554,953/A/. 8 Jun 1977. 19p. (In German).

The invention pertains to a driving unit in particular for vehicles, which consumes considerably less fuel than conventional drives. In addition, environmental pollution due to exhaust gases, in particular in city traffic, will be considerably reduced. According to the invention, this is achieved by combining the internal combustion engine with a hot-air turbine whose short-term power is considerably higher than that of the internal combustion engine. The resulting unit combines the advantages of both systems and can be operated more economically than conventional internal combustion engines.

VEHICLE DESIGN FACTORS

REFER ALSO TO CITATION(S) 50630

BODY AND CHASSIS

50635 Future use of aluminium in automobiles. Palazzo, F. (Fiat, Turin (Italy)). *Metall;* **31**: No. 11, 1274-1277(Nov 1977). (In German).

Aluminium and Aluminium compounds have found use long ago in the automobile industry due to the fact that they unite interesting physical, technological and economic properties. The advantages of using aluminium automobile construction are discussed in the article as well as the advantages resulting from light construction and the like, regarding fuel consumption of automobiles comparison tables show the use of aluminium in various models. A preview of the use of aluminium in various states supplements the article.

ENGINE SYSTEM

50636 Additional carburetor device improves rate of efficiency. *Antriebstechnik;* **16**: No. 8, 440-441(Aug 1977). (In German).

50637 Internal combustion engine with additional combustion chamber. Nakamura, N. (to Toyata Jidosha Kogyo K.K., Toyoata, Aichi (Japan)). German(FRG) Patent 2,556,078/A/. 23 Jun 1977. 15p. (In German).

The patent describes an internal combustion engine with a main combustion chamber and an additional combustion chamber. The two combustion chambers are connected by a connecting duct containing the spark plugs. The additional combustion chamber has a separate valve for fuel supply, so that an optimum construction is obtained. Overheating of the additional combustion chamber is prevented by constructive measures.

50638 Combustion engine with spark ignition. Sanda, S.; Nakamura, N. (to Toyota Jidosha Kogyo K.K., Aichi (Japan)). German(FRG) Patent 2,556,052/A/. 23 Jun 1977. 13p. (In German).

This patent is concerned with an internal combustion engine with spark ignition without an inlet valve in the additional combustion chamber. The main combustion chamber is connected with the auxiliary combustion chamber in the usual way by a connecting duct, in which the sparking plug is situated. The auxiliary combustion chamber has a hollow cylindrical body, which consists of heat resisting material.

50639 Combustion chamber for internal combustion engines with fuel-air mixture compression and spark ignition. Vorberger, G.; Mayr, B. (to Bayerische Motoren Werke A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,530,628/B/. 16 Jun 1977. 5p. (In German).

The article describes possible improvements in the design of combustion chambers for spark-ignited internal combustion engines where the ignition point is outside the eddy current occuring in the cylinder. In addition, the whole combustion chamber is tapered with regard to the ignition point. This results in soft but quite complete combustion of all components of the fuel-air mixture while at the same time removing temperature and pressure peaks, thus reducing the NOx concentration in the exhaust gas. Additionally, the thermal load on the spark plugs is lower due to the fact that the spark plug is only used for ignition and then remains in the shadow of the flame front.

50640 Double-piston internal combustion engine. Abou-Kamal, S. German(FRG) Patent 2,554,115/A/. 16 Jun 1977. 9p. (In German).

A rotary-piston internal combustion engine is described, which has a control piston controlling the gas change in the cylinder. The engine has the following advantages: 1) In comparison with other internal combustion engines higher power output is achieved at equal operational conditions. 2) Disadvantages of current engines are overcome. 3) One working stroke is performed per revolution. 4) The main piston only works for the compression or for the power stroke. The intake resp. exhaust stroke in performed by a lighter piston which has a simpler mechanism and with needs no crankshaft and no connecting rod. 5) No overheating zones will occur at the upper part of the cylinder, rather on exhausting, a large amount of heat is distributed over the whole cylinder.

50641 Rotating piston combustion engine. Ishikawa, Y. (to Nissan Motor Co. Ltd., Yokohama (Japan)). German(FRG) Patent 2,326,606/B/. 8 Jun 1977. 7p. (In German).

The invention has the purpose of forming a packing strip for a rotating piston combustion engine, so that in spite of high temperature differences and the associated local deformation of the side pieces and the high difference in pressure between adjacent working chambers, a good seal is guaranteed. This is achieved by the center of curvature of the middle part dome on one side and the centers of curvature of the corner domes on the other side of the piston corner parts always lying at the same spacing.

50642 Ignition circuit for combustion engines. Becker, H.W. German(FRG) Patent 1,464,066/C/. 26 May 1977. 7p. (In German).

The invention refers to the ignition circuit for combustion engines, which are battery fed. The circuit contains a transistor and an oscillator to produce an output voltage on the secondary winding of an output transformer to supply an ignition current. The plant is controlled by an interrupter. The purpose of the invention is to form such a circuit that improved sparks for ignition are produced, on the one hand, and that on the other hand, the plant can continue to function after loss of the oscillator. The problem is solved by the battery and the secondary winding of the output transformers of the oscillator are connected via a rectifier circuit to produce a resultant total voltage with the ignition coil from the battery voltage and the rectified pulsating oscillator output.

50643 Control device for a gas turbine plant for driving a motor vehicle. Greune, C.; Hackl, F. (to Motoren- und Turbinen-Union G.m.b.H., Muenchen (Germany, F.R.)). German(FRG) Patent 2,163,804/B/. 21 Apr 1977. 5p. (In German).

A control device for a gas turbine plant for driving a motor vehicle is described. The control parameter of the speed controller is determined by the speed of the turbine and the compressor inlet temperature. The incoming quantity of fuel is controlled. In particular according to the invention, compared with the usual controllers of this type, one should be able to keep variations of output in the gas turbine plant in the upper output range small, or prevent them altogether. According to the invention this is achieved by making the maximum value of turbine speed variable depending on the required maximum output of the gas turbine plant according to a function depending on the compressor inlet temperature.

50644 Process for the operation of internal combustion engines forming a working space. Tholen, P. (to Kloeckner-Humboldt-Deutz A.G., Koeln (Germany, F.R.)). German(FRG) Patent 2,542,981/A/. 31 Mar 1977. 4p. (In German).

Internal combustion engines are often supercharged by waste gas turbine super-chargers to increase the output. Coolers ensure that the maximum permissible temperatures are not exceeded on full load operation. On part load operation this leads to charging air temperatures which are too low for optimum ignition and combustion. A temperature increase in part load operation is achieved by the invention, where the charging air is partially led back to the suction side of the charger via a throttle valve. Because of the increased requirement for charging air the required temperature increase occurs, and this can be limited by a thermostatically controlled valve.

50645 Combustion chamber of a highly compressed combustion engine (four-stroke engine). Jung, R. German(FRG) Patent 2,534,344/A/. 17 Feb 1977. 9p. (In German).

The invention deals with measures that can be taken to guarantee a perfect, antiknock working of the motor despite reducing the lead content in particular in super fuels. An additional combustion chamber is made directly connected to the main combustion chamber. This may be carried out in already operating motors by separators to set back the spark plugs.

50646 Double-piston engine with circulating masses. Goedeckemeyer, U. German(FRG) Patent 2,535,542/A/. 17 Feb 1977. 9p. (In German).

A double-piston engine with circulating masses is described. Two double cylinders are connected to 4 gear wheels gripping into each other via cranked shafts in such a manner that cylinder and piston move in circular opposing ways and thus transfer the drive to a gear wheel. The motor works according to the two-stoke principle. A detailed construction is given.

50647 Piston engines and reciprocating engines. Harr, E. German(FRG) Patent 2,535,644/A/. 17 Feb 1977. 43p. (In German).

A reciprocating engine is described possessing the advantages of the usual reciprocating engines and rotating piston machines while avoiding their disadvantages. This is achieved in that the piston's center of gravity is not in the middle and can be rotated in the working chamber. A rotational movement around the longitudinal axis is achieved by leads during its reciprocating movememt in the direction of the longitudinal axis of the working chamber. The reciprocting movement of the piston is thus transferred to a rotational movement. Hence the advantages of a rotating piston engine may be obtained within its disadvantages.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 50700

50648 Equipment for control of quantities of exhaust gas returned. Rose, K.; Schillinger, R.; Ruhl, K.; Ringwald, P. (to Bosch (R.) G.m.b.H., Stuttgart (Germany, F.R.)). German(FRG) Patent 2,543,804/A/. 14 Apr 1977. 13p. (In German).

It is the purpose of the invention to create equipment for the control of quantities of exhaust gas returned. The adjustment of the exhaust gas return valve takes place directly dependent on the throttle flap setting. This is achieved constructionally by the suppressure line branching off immediately upstream of the throttle flap in the suction pipe, and contains a subpressure storage space with subpressure limitation valve. The valve controls a connection pipe in the suction pipe upstream of the branch of the subpressure pipe. In this way the subpressure storage space can be kept at constant working pressure to adjust the exhaust gas return valve independently of the working range of the machine.

50649 Exhaust gas inlet pipe with two air additions. Leistritz, H.K. German(FRG) Patent 2,534,855/A/. 17 Feb 1977. 5p. (In German).

The patent deals with a constructive improvement of the main patent claim P2533648.5 concerning an afterburner chamber for exhaust systems of automobiles. The improvement is achieved by already adding a first quantity of air within the exhaust gas inlet pipe and by not placing the ignition element inside the main chamber of the afterburner chamber but before the exhaust gas from the inlet pipe enters the combustion chamber and adding a second quantity of air by means of the ring injector described in the main patent.

50650 Electrochemical sensor for the determination of the oxygen content in exhaust gases, in particular in combustion motor exhaust gases. Weyl, H.; Steinke, L. (to Bosch (R.) G.m.b.H., Stuttgart (Germany, F.R.)). German(FRG) Patent 2,504,206/A/. 5 Aug 1976. 14p. (In German).

The invention deals with an electrochemical sensor to determine the oxygen content in exhaust gases (especially of internal combustion motors) by means of an oxygen concentration chain with ion-conducting solid electrolytes. The solid electrolyte has the shape of a tube at one end partly surrounded by a coaxially arranged casing. On its outer surface facing the exhaust gases it is at least partly coated with an electron-conducting, porous layer directly or indirectly electrically connected to a first electrical contact, and on its inner surface exposed to the surrounding air, it posesses an electron-conducting path reaching to the tube floor. This path is directly or indirectly electrically connected to a second electrical contact. A specified description of the geometrical details of the sensor is given.

50651 Electrochemical sensor for the determination of the oxygen content in exhaust gases, especially in internal combustion engine gases. Friese, K.H.; Topp, B. (to Bosch (R.) G.m.b.H., Stuttgart (Germany, F.R.)). German(FRG) Patent 2,504,207/A/. 5 Aug 1976. 12p. (In German).

An electrochemical sensor to determine the oxygen content in exhaust gases, mainly of internal combustion engines, by means of an oxygen concentration chain with ion-conducting solid electrolytes is described. The solid electrolyte has the shape of a tube closed at one end having an electron-conducting porous layer on at least part of the outer surface of the tube facing the exhaust gases. This layer is connected in a contact region to an electrically conducting casing. Between the electron-conducting layer and the outer surface of the solid electrolyte tube, there is an intermediate layer which also insulates at high temperatures and is at least below the contact region of the electron-conducting layer or the contact region of the conduction path and electrically insulates the layer or the conduction path from the tube.

NITROGEN OXIDES

REFER ALSO TO CITATION(S) 50622, 50623, 50624, 50627, 50638, 50639

50652 Equilibrium catalyst. Gandhi, H.S.; Shelef, M. (to Ford-Werke A.G., Koeln (Germany, F.R.)). German(FRG) Patent 2,638,300/A/. 10 Mar 1977. 14p. (In German).

The invention deals with an equilibrium catalyst to treat nitrogen oxides, carbon monoxide and unburned hydrocarbons occuring in waste gas flows from an internal combustion engine. The catalyst contains a catalyst substrate, rhodium, which possesses an excellent three-way selectivity and is used as equilibrium catalyst, an oxygen storage metal component to maintain the effectivity of the equilibrium catalyst during momentary deflections of the waste gases into oxygen-rich conditions, an active metal component for a water gas and steam reformation process keeping the overall effect of the catalyst when treating oxygen-defficient waste gases and a component for the oxidation for hydrocarbons and carbon monoxide.

CARBON MONOXIDE

REFER ALSO TO CITATION(S) 50622, 50623, 50624, 50627, 50638, 50652

HYDROCARBONS

REFER ALSO TO CITATION(S) 50622, 50623, 50624, 50627, 50638, 50652

ALTERNATIVE FUELS

50653 (HCP/W3684—01/2) **Identification of probable automotive fuels composition: 1985—2000. Executive summary.** (Southwest Research Inst., San Antonio, Tex. (USA); Standard Oil Co. of Indiana, Whiting (USA); SOHIO Petroleum Co. Cleveland, Ohio (USA); Cameron Engineers, Inc., Denver, Colo. (USA)). May 1978. Contract EY-76-C-04-3684. 50p. Dep. NTIS, PC A03/MF A01.

The principal factors and activities in the production of automotive fuels which have synthetic hydrocarbon constituents and alcohol fuels derived from coal are traced and discussed in detail. These include selection of reference raw materials, syncrude compositions for a variety of candidate conversion processes, and finished automotive fuels composition based upon domestic fuel demand projections for the time frame 1985-2000. In addition, those fuel-engine relationships pertinent to developing optimized automotive systems are discussed in relation to anticipated developments in propulsion systems technology. Projected compositions and performance of finished specification-quality automotive fuels for this time frame are not expected to differ significantly from those for today's fuels since it is anticipated that coal- or shale-derived syncrudes will be blended with dominant petroleum crudes at conventional petroleum refineries rather than at plants dedicated to the exclusive refining of synthetic crudes. Consequently, excessive undesirable compounds can be diluted to acceptable specifications levels by proportionate blending with petroleum feedstocks.

MATERIALS

50654 (SAND—77-0735(Suppl.A)) **Materials information data bank.** Mead, K.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 35p. Dep. NTIS, PC A03/MF A01.

The procedures for entering and retrieving information from the Materials Information Data Bank are described in detail.

50655 (UCRL—50028-78-1) **H-Division quarterly report, January—March 1978.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 May 1978. Contract W-7405-ENG-48. 34p. Dep. NTIS, PC A03/MF A01.

The various groups of H-division pursued work on the following subjects: Theoretical EOS (equation of state) Group--direct correlation function from analysis of the one-component dense plasma, theoretical analysis of Hugoniots of hydrocarbons, development of fast EOS generation code MIX for mixtures (based on a modified ideal mixing model) that can account for the reason observed boiling temperatures are spread over a finite interval, development of the fast EOS package PRET, a consistent nuclear correction that can be renormalized for statistical EOS models of the one-component plasma, use of a quantum statistical model to compute the pressure of compressed aluminum; Experimental Physics Group--Hugoniot parameters for three types of high-strength steel from 0 to 320 GPa, laser-driven shock-wave experiments at the Janus laser facility; Fluid Physics Group—fall disassembly and first-wall loading in the lithium fusion raeactor, numerical simulations of the Cabriolet event; Solid Mechanics Group--a plastic strain, mean-stress criterion for fracture for use with nuclear pressure vessles. 32 figures, 2 tables. (RWR)

50656 Calorimetric studies of choline chloride, bromide, and iodide. Petrouleas, V.; Lemmon, R.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **69**: No. 3, 1315-1316(1 Aug 1978).

Crystalline choline chloride is known to exhibit sensitivity to ionizing radiation. Measurements are reported for two other choline salts choline bromide and iodide on a differential scanning calorimeter and are extended to low temperatures to elucidate the radiation sensitivity of these salts.(AIP)

METALS AND ALLOYS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 49617

50657 (FE—2606-1) **Development of automated welding processes for field fabrication of thick-walled pressure vessels: electron beam method. First quarterly report, September 19, 1977—December 31, 1977.** Weber, C.M. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research and Development Div.). Jan 1978. Contract EF-77-C-01-2606. 11p. Dep. NTIS, PC A02/MF A01.

Progress is reported on a project to develop and demonstrate an electron beam welding procedure for welding 8" thick SA387 Grade 22 Class 2 (2-¼ Cr-1 Mo) steel.

50658 (K—1893) **Evaluation of the effect of impurities in nickel plate deposited from a Watts-type bath.** Daugherty, C.E.; Petit, G.S. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

This report covers a study made to evaluate the effect of ≦ 5 ppM of an octyl ortho-phthalate ester and varied amounts of iron contamination on the hardness of nickel plate deposited from a Watts-type nickel plating bath. The effect of iron contamination on the plate hardness was evaluated at 200, 400, 800, and 1,200 ppM in the bath. The amount of iron codeposited with the nickel at the various levels of iron contamination in the bath was also evaluated.

50659 (RFP—2668) **Microstructural stability of 21-6-9 stainless steel.** Krenzer, R.W.; Sanderson, E.C. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 18 May 1978. Contract EY-76-C-04-3533. 13p. Dep. NTIS, PC A02/MF A01.

Two experiments were designed to better define parameters for thermomechanical processing of 21-6-9 stainless steel. This steel is one of the nitrogen-strengthened chromium, manganese, and nickel austenitic stainless steels having mechanical properties that can be improved by a combination of plastic deformation and heat treatments. By heat-treating coupons, the time-temperature relationship of the precipitate phase, and the solutionizing, recrystallizing, and stress-relieving temperature ranges in 21-6-9 were established. Secondly, mechanical properties and microstructure as a function of percent deformation and stress-relieving temperature are reported.

50660 (SAND—78-0486C) **Compaction studies of palladium/aluminum powders.** Burchett, O.L.; Birnbaum, M.R.; Oien, C.T. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 27p. (CONF-780706—3). Dep. NTIS, PC A03/MF A01.

From 6. pyrotechnics seminar; Estes Park, CO, USA (17 Jul 1978).

A compaction study has been performed comparing predicted and experimentally determined density gradients in palladium/aluminum mixtures of differing weight fractions. A modified constitutive equation for porous media was used to predict the density gradients. The predicted density gradients correlated well with radiographic data obtained from radiographs of compacted pellets. The correlation has established that the density gradients in compacted pyrotechnic pellets can be analytically determined without resorting to difficult and time consuming radiographic methods.

50661 (UCID—17780) **Horizontal gas-tungsten-arc welding of 0.020-in. (0.5-mm) 1100 aluminum.** Carpenter, R.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Mar 1978. Contract W-7405-ENG-48. 14p. Dep. NTIS, PC A02/MF A01.

The procedure developed by the LLL Metals and Ceramics Division's Weld Development Laboratory for butt-welding 0.020-in. (0.5-mm) 1100 aluminum horizontally by means of the gas-tungsten-arc process is described. The depth of penetration was 100%, and sectioning showed the nugget to be free of porosity and other defects.

50662 (UCRL—13841) **SANL 605/006: subcontractor's report.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Mar 1978. Contract W-7405-ENG-48. 4p. Dep. NTIS, PC A02/MF A01.

The objective of this work was to hot-isostatically press (HIP) specimens containing a blend of nickel and sulfur powders. Two specimens containing nickel and sulfur powders were prepared. The processing conditions are given.

50663 (UCRL—80740) **Precision etching of thick-film circuits of aluminum and aluminum-0.1 wt% copper.** Wiesner, H.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Feb 1978. Contract W-7405-ENG-48. 24p. (CONF-780602—3). Dep. NTIS, PC A02/MF A01.

From 65. conference of American Electroplaters' Society; Washington, DC, USA (Jun 1978).

In certain high-current applications the resistance of the aluminum conductors is an important design parameter. Such a case is the aluminum exploding-bridge used in some nuclear detonators. The resistance of the network must be accurately known so that the individual bridge will receive the proper firing current. Vapor-deposited, thick aluminum films (0.011 mm) are often used to produce the necessary circuitry. These films are suitably masked and etched to make the conductors. Conventional etching methods for aluminum or aluminum-0.1 wt percent copper do not yield conductors with a well-defined, reproducible cross section. This results in unacceptable variations in electrical resistance. For this application, we have developed a new etching solution that contains 25 to 50 vol percent polyphosphoric acid, 75 to 50 vol percent orthophosphoric acid, and 10 to 30 g/l ferric chloride. Etching may be done at 55 to 65°C, but for precision etching the temperature should be controlled to +-1°C. The solution is useful for dip etching of aluminum circuits. The paper describes some limited production experience with this etch.

50664 **Zircaloy cladding fabrication: an overview.** Naylor, T.D.; Schemel, J.H. (Sandvik Special Metals Corp., Kennewick, WA). *Trans. Am. Nucl. Soc.;* **28**: 328-329(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50665 **Steels for large-diameter steam pipes.** Vorokhanova, M.F. (Cent Sci Res Mach Inst, USSR). *Teploenergetika (Moscow);* No. 10, 38-40(Oct 1977). (In Russian).

An investigation into the structure and properties of the metal of large-diameter pipes manufactured in accordance with different technological methods (Smith forging, hot forming, centrifugal casting, pipe seam welding) is described. Tests of pipe with the diameter from 500 to 1100 mm and with walls from 40 to 100 mm thick, made of steel 15Kh1M1F (15Cr1Mo1V), were carried out and their results are presented.

50666 **Main trends in the development of production techniques for steel used for gas and oil pipelines in the USSR.** Shalimov, A.G. (I.P. Bardin Cent Sci-Res Inst of Ferrous Metall, USSR). *Met. Sci. Heat Treat. (USSR) (Eng. Transl.);* **19**: No. 7/8, 541-542(Jul-Aug 1977).

Due to the use of spiral-seam oil and gas pipe of large diameter it is possible to roll the pipe steel in cast slabs in continuous strip mills. The optima rolling parameters are as follows: coiling temperature 570-600$degree$, final rolling temperature 780-850$degree$, depending on the thickness of the strip; 35-40% reduction in the last three stands; 25-30% reduction in the last two stands.

50667 **Acicular ferrite hsla steels for line pipe.** Coldren, A.P.; Mihelich, J.L. *Met. Sci. Heat Treat. (USSR) (Eng. Transl.);* **19**: No. 7/8, 559-572(Jul-Aug 1977).

By combining strengthening by grain refinement, dislocation substructure and precipitation in a low-carbon (0.06% C max.) steel, yield strength values in the range of 450-550 MPa have been produced in commercial pipe steels having good low-temperature toughness and excellent weldability. The grain refinement and dislocation substructure are obtained by controlling (lowering) the $\gamma \rightarrow \alpha$ transformation temperature through additions of 1.6%-2.2% Mn and 0.25%-0.40% Mo to suppress nucleation of polygonal ferrite and pearlite. The resulting matrix microstructure is acicular ferrite. Additional strengthening within the matrix is produced by precipitation of ultrafine (<20 A) particles of Nb(C, N) obtained by an addition of 0.03%-0.10%Nb. A substantial amount of precipitation occurs during air cooling from rolling. Additional precipitation strengthening (70-135 MPa) can be obtained by a subsequent aging treatment at 580-650°C. The as-rolled yield strength of Mn-M0-Nb acicular ferrite steels is not sensitive to plate mill rolling variables, but the impact toughness properties are. 18 refs.

50668 (ORNL-tr—4571) **Structural characterization of fritted tungsten alloys: W—Ni—Fe, W—Ni—Co, and W—Ni—Cr.** Margaria, T.; Allibert, C.; Driole, J. Translated by S.D. Blalock Jr. from *J. Less-Common Met.;* **53**: 85-95(1977). 11p. Dep. NTIS, PC A02/MF A01.

Within the framework of research on alloys having a greater hardness, a preliminary study bearing on the W-Fe-Ni alloy was undertaken. It permitted the structure of the product to be connected with its mechanical properties and the study of new alloys such as W-Ni-Cr was undertaken. Produced industrially by powder metallurgy, this alloy has its total composition (in weight) as: W-93 percent; Ni-4.6 percent; Fe-2.4 percent. (GHT)

50669 (RFP-Trans—244) **Experiment in the explosive forming of refractory metals.** Medzyanovskii, E.B. Translated from *Kuznechno-Shtampovochnoe Proizvod.;* No. 2, 25-27(1969). 5p. Dep. NTIS, PC A02/MF A01.

Use of a pyrotechnic composition spread over the surface of the material to be formed permits rapid heating of the material leading to greater ductility at the time of explosive forming. The method also permits greater latitude in the choice of the transmission medium used with the explosive charge. The method is described for molybdenum and tungsten. (GHT)

STRUCTURE AND PHASE STUDIES

50670 (SAND—78-1091C) **Quantitative depth profiling of disorder in Si on sapphire: influence of annealing ambient.** Picraux, S.T.; Rai-Choudhury, P. (Sandia Labs., Albuquerque, N.Mex. (USA); Westinghouse Research Labs., Pittsburgh, Pa. (USA)). 1978. Contract EY-76-C-04-0789. 10p. (CONF-780571—4). Dep. NTIS, PC A02/MF A01.

From 153. meeting of the Electrochemical Society; Seattle, WA, USA (21 May 1978).

The ion channeling technique is applied to quantitative determinations of the depth profiles of the crystalline quality of Si-on-sapphire (SOS), and the first channeling studies of the influence of annealing temperature and ambient on the reduction of stacking faults and microtwins in as-grown SOS layers are presented. The results indicate that annealing at 1150°C for 24 minutes in N_2 and in $N_2 + O_2$ results in factors of 2 and 4 reduction in the disorder density, respectively; whereas, no appreciable reduction in disorder is obtained for 1200°C anneals in N_2 or in O_2 + 1% HCl. A preliminary model to explain the disorder reduction is proposed.

50671 **de Haas—van Alphen effect in the high-T/sub c/ A 15 superconductors Nb_3Sn and V_3Si.** Arko, A.J.; Lowndes, D.H.; Muller, F.A.; Roeland, L.W.; Wolfrat, J.; van Kessel, A.T.; Myron, H.W.; Mueller, F.M.; Webb, G.W. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **40**: No. 24, 1590-1593(12 Jun 1978).

de Haas—van Alphen (dHvA) oscillations have been observed in Nb_3Sn in the (110) plane and in V_3Si at two orientations using single crystals of high resistance ratio and magnetic fields in excess of H/sub c/2. The dHvA frequency data for Nb_3Sn can be interpreted as a series of nested ellipsoids centered at M, as suggested by a recent high-precision calculation of the Nb_3Sn Fermi surface.

50672 **Mo(001) surface: A self-consistent calculation of the electronic structure.** Kerker, G.P.; Ho, K.M.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **40**: No. 24, 1593-1596(12 Jun 1978).

A self-consistent pseudopotential calculation for an unrelaxed Ma(001) surface reveals strong surface states and resonances. The results are used to interpret the sharp peak structure near the Fermi level and other structures measured by recent angle-resolved photoemission experiments. The structure is attributed uniquely to surface states and resonances. Contrary to other proposals, relativistic, many-body, and surface-contraction effects are not necessary to explain the observed spectra.

50673 **Crystal structure and superconductivity of Pb—Sb alloys subjected to high pressures.** Degtyareva, V.F.; Ivakhnenko, S.A.; Ponyatovskii, E.G.; Rashchupkin, V.I. (Institute of Solid-State Physics, Academy of Sciences of the USSR, Chernogolovka, Moscow Province). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 2, 238-241(Feb 1978).

An investigation was made of the structure of Pb—Sb alloys (with 20, 30, and 50 at.% Sb) after the application of a pressure of P=50 kbar at T=350 °C and "quenching" to -170 °C, followed by reduction in pressure to the atmospheric value. Two new intermediate phases were observed: a bcc phase β with a=3.894 +- 0.005 A and an hcp phases ϵ with a=3.461 +- 0.003 A and c=5.714 +- 0.005 A. A study was made of the conversion of these phases to the initial eutectic mixture as a result of heating of the "quenched" alloys to room temperature. The temperature of the transition to the superconducting state during heating was determined for the "quenched" alloys and intermediate states. It was found that this

transition temperature was T/sub c/=8.5 °K and T/sub c/=8.2 °K for the β and ϵ phases, respectively.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 49942, 50005, 50222, 50224, 50287, 50668

50674 (BNL—24102) **Influence of stresses on superconducting properties of Nb_3Sn conductors.** Suenaga, M.; Luhman, T.S.; Sampson, W.B.; Onishi, T.; Klamut, C.J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 27p. (CONF-780124—3). Dep. NTIS, PC A03/MF A01.

From Workshop on the development of superconductors for fusion power; Germantown, MD, USA (26 Jan 1978).

This investigation of the degradation in the superconducting properties of Nb_3Sn conductors when subjected to mechanical strain can be divided into the following areas: (I) monofilamentary Nb_3Sn wires, (II) multifilamentary Nb_3Sn conductors and wires, (III) effects of additives to Nb_3Sn, (IV) mechanisms for degradation, and (V) construction of test facilities. Efforts to the present time have been concentrated in the investigation of T/sub c/, J/sub c/, and H/sub c2/ variations in monofilamentary wires. The most important finding in this study is that a Nb_3Sn composite wire can sustain an effective mechanical strain well beyond "1%" if a proper ratio of the matrix to the Nb core has been chosen.

50675 (LBL—6983) **Investigation of wear resistant material using dispersed phase intermetallic compound of nickel—titanium—silicon in an iron matrix.** Steinmetz, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1977. Contract W-7405-ENG-48. 65p. Dep. NTIS, PC A04/MF A01.

Thesis.

The physical and mechanical properties of iron powder blended with a hard intermetallic compound, Ni_3Ti_2Si, were studied in the as-sintered condition. The influence of the morphology on the wear tests was investigated using a pin-on-disk wear test machine. The variables affecting the morphology of this system have been experimentally determined.

50676 (ORNL/NUREG/TM—194) **Heavy-Section Steel Technology Program. Quarterly progress report, October—December 1977.** Whitman, G.D.; Bryan, R.H. (Oak Ridge National Lab., Tenn. (USA)). 12 Apr 1978. Contract W-7405-ENG-26. 85p. Dep. NTIS, PC A05/MF A01.

The Heavy-Section Steel Technology (HSST) Program is an engineering research activity conducted by the Oak Ridge National Laboratory for the Nuclear Regulatory Commission. It comprises studies related to all areas of the technology of the materials fabricated into thick-section primary-coolant containment systems of light-water-cooled nuclear power reactors. The principal area of investigation is the behavior and structural integrity of steel pressure vessels containing cracklike flaws. Current work is organized into seven tasks: program administration and procurement, fracture mechanics analyses and investigations, effect of high-temperature primary reactor water on subcritical crack growth, investigations of irradiated materials, pressure vessel investigations, thermal shock investigations, and foreign research. The stress—intensity factors measured photoelastically for nozzle corner cracks compare well with calculated values except for shallow flaws, in which case results may be sensitive to differences in crack shape. Fatigue testing of weld metal was completed, and ramp- and hold-time studies of forging material continue. Charpy specimens of irradiated weld metal with low ductile shelf toughness were tested, and other preparations for J-integral testing of larger specimens of this material were made. Procedures and equipment for flawing vessel V-8 were demonstrated to be satisfactory, and material properties of this vessel were studied. A facility for performing thermal shock experiments with liquid nitrogen was completed. Studies of enhanced heat transfer from coated cylinders continued.

50677 (ORNL/NUREG/TM—194, pp 25-35) **Effect of high-temperature primary reactor water on the subcritical crack growth of reactor vessel steels.** Bamford, W.H.; Moon, D.M.; Ceschini, L.J. 12 Apr 1978.

In Heavy-Section Steel Technology Program. Quarterly progress report, October—December 1977.

Cracks in these specimens are oriented along the center of the weld. Crack growth in weldments was observed to increase with the range of applied stress-intensity factor for a time, after which a severe deceleration occurred. Ramp- and hold-time effects were studied for 2-in. specimens of A508 class 2 forging material; clear conclusions could not be drawn. Crack growth in PWR environment occurred by ductile striation formation in the base metal and void coalescence in the weld specimens. Possible effects of hydrogen are considered. 6 figures, 1 table. (RWR)

50678 (SAND—77-1570) **Study of deformation and fatigue of 316 stainless steel at room temperature by positron annihilation.** Gauster, W.B.; Wampler, W.R.; Jones, W.B.; Van Den Avyle, J.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1978. Contract EY-76-C-04-0789. 39p. (NUREG/CR—0118). Dep. NTIS, PC A03/MF A01.

Scoping studies have been initiated to evaluate the potential of positron annihilation as a volumetric nondestructive examination technique. The first experiments have shown that positron annihilation provides a sensitive monitor of plastic deformation caused by cold rolling and of fatigue cycling of 316 stainless steel at room temperature. Transmission electron microscopy examination of the fatigued samples has shown a direct relationship between dislocation density and the positron annihilation measurements. The effects of changing the strain amplitude of the fatigue cycling are also observed to be significant. The goal of these studies is to determine the positron annihilation response to high temperature creep and creep/fatigue damage encountered in advanced nuclear reactor components.

50679 (SAND—78-0462) **Mechanical properties data of candidate alloys for earth penetrator structural components.** Van Den Avyle, J.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1978. Contract EY-76-C-04-0789. 50p. Dep. NTIS, PC A03/MF A01.

Loading modes imposed on earth penetrators during impact and subsurface travel include high rate axial compressive stresses and possibly large tensile bending stresses caused by off-axis impacts or collisions with hard sub-surface objects. These modes require that case structural alloys possess a high yield strength to prevent yielding under compressive loads and also possess high fracture toughness to resist fracture under tensile loading at stress concentrations. Tensile data were generated at intermediate strain rates (epsilon less than 300 sec^{-1}) between 219 and 344°K for four candidate steels (9-4-20, maraging 250, HY-180, and D6AC). In general, yield strengths varied less than 10 percent over the ranges of strain rate and temperature tested. Charpy impact energy measurements on 9-4-20 showed a 10 percent decrease in toughness at low temperatures for samples subjected to a simulated heat-shrink fitting procedure. Additional fracture toughness tests (K/sub IC/) were conducted on 9-4-20 with varied tempering treatments and on two forged billets of HY-180. Strength and toughness data for several candidate alloys gathered from the literature are presented, and recommendations are made for trade-offs in strength versus toughness.

50680 (UCID—17787) **Comparison of the acoustic emission generated by tensile and compressive testing of 7075 aluminum.** Hamstad, M.A.; Mukherjee, A.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Apr 1978. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

An experimental study of the acoustic emission generated during tensile and compression testing of unflawed 7075 aluminum has been completed. Variables studied included: specimen orientation in a 13-cm plate, 1, 3 and 4.8 percent plastic stretches before the aging heat treatment, and 7075-T6 vs 7075-T651. The level of acoustic emission for strains greater than 1.5 percent was about two orders of magnitude greater in tension than in compression. In the T-6 state the acoustic emission level generated at first macroscopic yielding is about the same in both tension and compression tests. Samples of 7075-T6 can be distinguished from 7075-T651 by the acoustic emission generated during a simple compression test and for both tension and compression tests the acoustic emission is of higher level when the loading axis is perpendicular to the rolling plane.

50681 **Ion-beam study of Sb trapping in Fe-Ti-Sb-C alloys.** Myers, S.M.; Follstaedt, D.M.; Rack, H.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Appl. Phys. Lett.;* **33**: No. 5, 396-398(1 Sep 1978).

Using ion-backscattering analysis and transmission electron microscopy of ion-implanted alloys, it is shown that TiC precipitates in Fe are effective traps for Sb. This trapping is proposed as a contributing mechanism for the reduced temper embrittlement susceptibility observed in steels containing Ti.

50682 **Effect of hardening and embrittlement on energy dissipation in strain aging of structural steels for nuclear power plants.** Astaf'ev, A.A.; Zanin, V.N.; Markov, S.I.; Chaikovskii, B.S.; Yukhanov, V.A. (Cent Sci Res Mach Inst, Moscow, USSR). *Probl. Prochnosti;* No. 10, 94-102(Oct 1977). (In Russian).

The aging of structural perlitic steels based on Cr-Ni-Mo-V and Mn-Ni-Mo for nuclear power plants is investigated. The mechanisms of energy dissipation for different states of the material are determined. Correlations between the damping and the criteria of evaluation of the tendency of steels to strain aging are found. The nature of variation of the tendency of the investigated materials to the activation of plastic deformation during strain aging under the effect of different factors is explained. 12 refs.

50683 Causes of premature failure of the metal of boiler heating surfaces. Tulyakov, G.A.; Sokolyanskii, B.M. (Cent Sci Res Mach Inst, USSR). *Teploenergetika (Moscow);* No. 10, 40-43(Oct 1977). (In Russian).

An investigation into the causes of premature failure of metal of some boiler heating surfaces carried out on the metal of unheated superheater bends consisting of steel 12Kh1MF (12Cr1MoV) of a TP-100 boiler operating in maneuvering conditions is reported. In the course of 8 years of operation there were 7200 changes of operating conditions. Electron microscopic and mechanical tests show that the main cause of premature failure of pipe bends was interaction betwen creep and thermal fatigue.

50684 (BNWL-tr—310) **Study of the reversible temper brittleness kinetics for carbon steels and lightly alloyed steels.** Lagrange, J.; Maynier, P.; Palmier, M.M.; Ponsot, A.; Dollet, J. Translated from *Mem. Sci. Rev. Metall.;* **74**: 757-763(1977). 11p. (CONF-7705126—1). Dep. NTIS, MF A01.

From 16. meeting on special steels; Belfort, France (11 May 1977).

Portions of document are illegible.

To establish a mathematical model which represents with sufficient accuracy the kinetics of reversible temper embrittlement, the literature exhibits an excellent collection of the results obtained about twenty years ago by Jaffe and Buffum on SAE 3140 Ni-Cr steel. On the basis of these transition curves, one can propose a mathematical model which utilizes the most recent theories and results. This model assumes three principal functions: segregation, diffusion and reversion. The segregation function is based on McLean's theory, picked up by Hondros, Seah and Guttmann. The diffusion function finds the diffusiveness value of phosphor in the iron α given by Gruzin and Mural in 1974. Finally, the reversion function expresses an indisputable realiy of embrittlement reversion at 525 and 575°C. Its cause is the subject of non-definitive discussions (desegregation, recrystallization or α grain enlargement). The proposed model assumes for an initial embrittlement of over 100°C α Level sigma dispersion of 8°C.

50685 Prochnost' i plastichnost' tugoplavkikh metallov i monokristallov. (Strength and plasticity of refractory metals and monocrystals). Ivanova, V.S.; Ermishkin, V.A. Moscow; Metallurgiya (1976). 80p.

Contemporary theories of the temperature relationship of the stress flow and work hardening of refractory body-centered cubic monocrystals and methods for studying dislocation dynamics are presented. An examination is made of dislocational structure evolution in deformation, slip geometry (with consideration given to direct observation data in a high-voltage electron microscope) as well as the influence of dislocation dynamic properties on the behavior of monocrystals of refractory body-centered cubic metals during deformation. The book is designed for specialists in metals science and the physics of metals, scientists, engineers, and graduate students. 37 illustrations, 15 tables, 170 refrences.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 50673, 50674

50686 (COO—4381-4) **Study of oxide interlayers formed reactively at a silver-electrolyte boundary.** Sari, S.O.; Huber, E.D. (Arizona Univ., Tucson (USA). Optical Sciences Center). 1978. Contract EG-77-S-02-4381. 12p. Dep. NTIS, PC A02/MF A01.

The differential reflectance of reactively oxidized versus unoxidized silver foils in aqueous potassium hydroxide was measured in the 1.5 to 5 eV energy range. From these results the imaginary part of the dielectric constant of the oxide can be determined directly in the free-electron region of silver, and the zero-frequency interband contribution to the dielectric function of the oxide-covered metal can be estimated. The scattering contribution to the reflectance from the oxide surface nonuniformities is discussed. 3 figures.

50687 (EUR—5604) **Application of a non-dynamometric method to the measurement of the coefficient of static friction in cold and hot water between stainless steel and two alloys of zirconium.** D'Agraives, B.C.; Toornvliet, J. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1977. 32p. (In French). Dep. NTIS (US Sales Only), PC A03/MF A01.

A method is proposed to perform comparative measurements of the coefficient of friction, either in cold water (25°C) or in hot pressurized water (240°C). For the purpose, a pin-on-disc tribometer, working with no force transducer, in which the coefficient of friction μ is measured through an angle 0, and given by $\mu = K \sin 0$ is used. The method is presently applied to the determination of the incipient friction along a distance of few millimetres. At low speed (1 mm/s) and with light contacts loads (from 50 to 150 g), two different friction mechanisms are observed for the following couples of materials; Zircalloy 2/304L stainless steel, Zirconium Niobium 2.5/304L stainless steel, 304L stainless steel/304L stainless steel. The first mechanism, which is observed essentially in cold conditions, is characterized by a regular sliding since friction starts, whereas the second appears mostly in hot conditions and shows peaks of friction with irregular and scattered values of μ. These two mechanisms seem to be related to intermetallic affinity of the mating materials, and also to the existence of preoxydized surface layers, and, to a large extent, to the change in the water viscosity. In such conditions, it appears that it is not possible to replace friction experiments in hot water by easier experiments in cold water.

50688 Kr^{85} autoradiography for nondestructive/noncontaminating surface porosity measurements. Mattox, D.M.; Sowell, R.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). pp 2659-2662 of Proceedings of the seventh international vacuum congress and the third international conference on solid surfaces. Vol. 3. Dobrozemsky, R.; Ruedenauer, F.; Viehboeck, F.P.; Breth, A. (eds.). Vienna; Oesterr. Studiengesellschaft fuer Atomenergie G.m.b.H. (Sep 1977).

From 7. international Vac. congress and 3. international conference on solid surfaces; Vienna, Austria (12 Sep 1977).

The use of autoradiography of absorbed krypton-85 for the measurement of surface porosity of ceramic substrates used for hybrid microcircuit fabrication is described. This porosity test gives a visual and permanent record of the relative size and distribution of surface porosity. The test is nondestructive and leaves no residual contamination which would be difficult to remove. Using this porosity test, it has been found that surface porosity of commercially-available ceramic substrate material may vary significantly between vendors, within a single lot from one vendor, and over a single substrate. Porosity tests on metallized substrates show that ceramic surface porosity is reflected in porosity of the metallized substrate This porosity test allows the pore-filling ability of various metallization techniques to be evaluated. Krypton-85 is not biologically active and thus presents a limited radiological hazard.

50689 (LBL—7333) **Mechanisms of material removal in the solid particle erosion of ductile materials.** Mayville, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 41p. Dep. NTIS, PC A03/MF A01.

Thesis.

The behavior of materials subject to erosion has been studied extensively in the last 20 years, yet little is known about the physical mechanisms of material removal. This work is an attempt to determine the mechanisms by which material is removed from a ductile metal surface when subjected to the impingement of a stream of angular abrasive particles. The particular case considered is one where the stream impinges at angles that are nearly normal to the average surface. In this case, material appears to be removed in the form of platelets that result when a protrusion from the average surface is severely plastically deformed (as if being spread over the surface) by the impingement of a smooth side of a particle.

50690 Spectral functions of disordered alloys. Kaplan, T.; Gray, L.J. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., B;* **17**: No. 12, 4607-4613(15 Jun 1978).

We describe the application of the augmented-space formalism to the calculation of spectral functions of disordered alloys. Results for three-dimensional alloy models with diagonal and off-diagonal disorder are presented. Good overall agreement is obtained when these results are compared with the cluster calculations of Alben et al.

50691 Isotope effect for diffusion of zinc and copper in aluminum. Peterson, N.L.; Rothman, S.J. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B;* **17**: No. 12, 4666-4673(15 Jun 1978).

The isotope effect for the diffusion of copper in aluminum is 0.81 +- 0.05 at 656.9 °C and 0.89 +- 0.05 at 584.7 °C. The isotope effect for the diffusion of zinc in aluminum increases from $\sim$ 0.35 at 415 °C to $\sim$ 0.6 at 654 °C with a temperature dependence of 0.1 eV. These results and earlier diffusion data indicate that the impurity-vacancy binding energy is small in aluminum, but they do not resolve the controversy concerning the extent of the divacancy contribution to self-diffusion in aluminum.

50692 Theory of magnetostriction of electron-hole drops in Ge. Markiewicz, R.S. (Department of Physics, University of California and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., B;* **17**: No. 12, 4788-4806(15 Jun 1978).

A large mass of electron-hole liquid (γ drop) formed in a strain-induced potential well in Ge is known to distort its shape significantly in a magnetic field $B >$ or $\simeq 1$ kG. It is shown in this paper that the shape change can be understood in detail as due to a "recombination current" of electron-hole pairs needed to replace those pairs which recombine in the drop volume. The Lorentz force deflects this current and produces a macroscopic dipole current loop

inside the drop. The drop then changes shape to minimize its total energy, including magnetic, strain, and surface energies. While the drop usually flattens along the field direction, both para- and diamagnetic effects (elongated drops) are found to be possible, depending on excitation conditions, in accord with experiment. Similar effects are predicted to occur in small drops in unstrained Ge. This paper presents a magnetohydrodynamic theory of the magnetostriction which takes into account density variations which occur in the strain well and in high magnetic fields. A simpler theory is given for the special case in which the drop may be considered incompressible (small drops and moderate fields). Effects of carrier mass anisotropy and fluid viscosity are taken into consideration.

50693 Inhomogeneous state of superconductors by intense tunnel injection of quasiparticles. Gray, K.E.; Willemsen, H.W. (Argonne National Laboratory, Argonne, Illinois). *J. Low Temp. Phys.;* **30**: No. 11, 911-925(1 Jun 1978).

Measurements of the current—voltage characteristics of a tunnel junction as a function of quasiparticle injection from a second tunnel junction are presented. Aluminum films (300 A thick) are studied from the transition temperature down to about 0.35 K. For a certain range of injection currents, there exists an inhomogeneous energy gap and tunnel current; the large gap approximates the undisturbed film, while the value of the small gap depends on the specific resistance of the injector junction in a regular and calculable way. There is an instability which leads to this inhomogeneous state; although these experiments cannot unambiguously determine the mechanism of the instability, we show that severe problems are found in trying to explain it in terms of existing models. On the basis of our results and analysis, the instability apparently occurs because of small spatial inhomogeneities in the films and the extremely nonlinear current—voltage characteristics of tunnel junctions, rather than intrinsic properties of the superconductor. This result does not disprove the other models of instability, but shows the limitations of tunneling for investigating the models.

50694 Thermophysical properties of monobismuthides of rare-earth metals of the yttrium subgroup. Kovenskaya, B.A.; Abdusalamova, M.N.; Abdusalyamova, M.N.; Abulkhaev, B. (Institute of Problems in the Study of Materials, Academy of Sciences of the Ukrainian SSR). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 846-849(Mar 1978).

Measurements were made of the thermal expansion and thermal conductivity of the monobismthides of gadolinium, terbium, dysprosium, holmium, and erbium. For the first time, the measurements were performed on a series of samples of identical composition, obtained using a single technique. The measurements were carried out in the temperature range 300—900°K. From the results obtained it follows that the main contribution to the overall thermal conductivity of the compounds studied is due to the phonon component. An increase in the thermal expansion coefficient and decrease in the phonon component of the thermal conductivity is noticed in the series GdBi-TbBi-DyBi-HoBi-ErBi. An inference is made concerning the weakening of interatomic bonding in this series of compounds.

50695 Effect of low-temperature continuous and cyclic heating on the electrical resistance of brand VA tungsten and brand VR-20 tungsten — rhenium alloy. Museliani, V.S.; Vertogradskii, V.A.; Skazin, V.E.; Shmulevich, R.S. (V. I. Lenin Georgian Polytechnic Institute). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 938-940(Mar 1978).

Measurements were made at 1200, 1500, and 1800°C on W and W-Re wires of the dependence of the electric resistance on temperature α character of heating. The samples were prepared by the method of powder metallurgy.(AIP)

50696 Some features of the change of physical properties in a tungsten-zirconium system. Zaichenko, V.M.; Zaratskii, E.B.; Makarov, P.V.; Povorova, K.B.; Savitskii, E.M.; Chekhovskoi, V.Y. (High-Temperature Institute, Academy of Sciences of the USSR). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 943-945(Mar 1978).

The thermal expansion of tungsten-zirconium alloys of the following compositions: W+2.9 wt.% Zr, W+7.42 wt.% Zr, W+10.09 wt. %Zr, and Lavesse-phase W_2Zr, was studied using a quartz dilatometer. The investigation was carried out in the temperature range 100—900°C.

50697 Nonlinear magnetic resonance behavior and reversible adsorbed gas effects from trace ferromagnestism in Y-zeolite. Iton, L.E. (Princeton Univ., NJ). *J. Magn. Resonance;* **27**: 69-81(1977).

Unusual spin resonance observations made on a sample of rare earth ion-exchanged Y-zeolite have been attributed to the presence of a ferromagnetic impurity, and are qualitatively explained in terms of existing theories on nonlinear behavior in ferromagnetic resonance at high power. The effects included foldover and bistable response below 136 K, due to classical, anisotropy-based nonlinearity; above 136 K, apparent subsidiary absorption—the Suhl instability driven by coupling of low-frequency spin wave modes to the main resonance—predominated. Modification of the surface anisotropy is suggested to account for the complete suppression of the low-temperature effects when the zeolity sample was cooled in air, the high-temperature effects persisting after this cooling but with a loss of orientational anisotropy. Brief room temperature evacuation of the sample was sufficient to regenerate the original effects. Some details of the resonance behavior are very similar to recently published observations from magnetite impurities; those were there attributed to field-induced transitions. The limitations under which a field-dependent Verwey transition could be used to rationalize such observations have been schematically expounded, and the importance of the microwave field again appears to be the dominating factor.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 49365, 49745, 49761, 49938, 49945

50698 (LBL—7604) Corrosion of iron-base alloys by coal char at 871° and 982°C. Gordon, B.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1978. Contract W-7405-ENG-48. 111p. Dep. NTIS, PC A06/MF A01.

Thesis.

The high pressures and temperatures required for the processing of coal lead to accelerated corrosion of gasifier components by oxygen and sulfur present in the gas phase. Coal char, the solid byproduct of coal processing, contains sufficient inorganic sulfur to result in internal attack of the alloys composing the gasifier components. The role of coal char in coal processing and of thermodynamics in gas phase corrosion are discussed. Experiments were performed to determine whether $CaSO_4$ or FeS are responsible for the internal attack on Fe—Cr—Al and Fe—Cr—Ni alloys observed under conditions of both high oxygen partial pressure and 982°C and low oxygen partial pressure and 982°C. Exposure at 871°C resulted in virtually no attack from coal char and FeS and very slight attack from $CaSO_4$. The morphologies and rates of attack indicate that at very low oxygen partial pressures (about 10^{-19} atmosphere) the presence of $CaSO_4$ can result in internal sulfidation whereas at higher oxygen partial pressures (about 10^{-15} atmosphere), the presence of FeS can result in internal sulfidation. Comparison of these results with those actually observed from coal char at 982°C indicate that FeS is primarily responsible for attack by coal char but that $CaSO_4$ can also result in such attack although the overall mechanism and rate of attack may be different.

50699 Is non-corroding steel only resistent against corrosion in water with high oxygen content. Herbsleb, G.; Schwenk, W. (Mannesmann-Forschungsinstitut G.m.b.H., Duisburg (Germany, F.R.)). *Gas- Wasserfach, Wasser - Abwasser;* **119**: No. 2, 79-80(Feb 1978). (In German).

50700 Materials and coatings for thermal reactors to control automotive emissions. Tamba, A.; Fortunati, S. (Cent Sper Metall, Rome, Italy). *Termotecnica (Milan);* **32**: No. 1, 62-67(Jan 1978). (In Italian).

Following the legislative action in the United States to control pollultants in automotive emissions, a technological drive regarding the selection of appropriate materials for the realization of thermal reactors to convert carbon monoxide and unburst hydrocarbons at high temperatures (900-1050$degree$C) to CO$sub 2$ and water has been launched. The research conducted with this purpose in view by the Centro Sperimentale Metallurgico in Rome, Italy, is described. Methods of evaluation based essentially on prolonged cyclic oxidation applied to a range of available materials are presented. As a result of tests, Cr-Al diffusion coatings in association with metallic films deposited by different methods are shown to be particularly suited to protect ferritic steels. Their cost is moderate. A family of ferritic stainless steels has been developed as the best competitive material from the point of view of costs and pefromance.

50701 Investigation of the effect of heat flux on the process of steel oxidation by a supercritical pressure medium. Glebov, V.P.; Zusman, V.M.; Taratuta, V.A. (Cent Boiler and Turbine Inst, USSR). *Teploenergetika (Moscow);* No. 10, 63-66(Oct 1977). (In Russian).

Experimental data characterizing corrosion resistance of boiler steels in a supercritical pressure medium in the presence of a heat flux through the coordinating metal surface and without it are presented. The perlitic steel 12Kh1MF (12Cr1MoV) and the austenitic steel Kh18N10T (Cr18Ni10Ti) were tested in two closed loops with natural circulation. It is found that an excess of the metal temperature of the internal pipe surface over the temperature of the medium flowing through it does not have any great effect on the amount of corrosion losses. The corrosion process is determined by

the temperature of the metal. A formula and a nomogram for determination of the corrosion rate depending on temperature and period of operation are presented.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 50139, 51467

50702 (ORNL/NUREG/TM—194, pp 36-38) **Toughness investigations of irradiated materials.** Berggren, R.G.; Jones, T.N.; Woods, J.W.; Canonico, D.A. 12 Apr 1978.

In Heavy-Section Steel Technology Program. Quarterly progress report, October—December 1977.

Impact tests were conducted on 74 Charpy V-notch specimens irradiated near 288°C. All tests show radiation-induced increases of Charpy transition and onset of upper-shelf temperatures and decreases of ductile (upper shelf) fracture energy and lateral expansion for average irradiation temperatures as high as 345°C. 1 table. (RWR)

50703 (ORNL/NUREG/TM—194, pp 38-40) **J/sub Ic/ values of irradiated ASTM A533, grade B, class 1, steel at 177°C.** Williams, J.A. (Hanford Engineering Development Lab., Richland, WA). 12 Apr 1978.

In Heavy-Section Steel Technology Program. Quarterly progress report, October—December 1977.

The J/sub Ic/ fracture toughness of ASTM A533 grade B, class 1, steel irradiated to 2.5 to 2.7 x 10^{19} neutrons/cm^2 at 290°C was determined by use of 10-mm-thick compact specimens. Testing was done at 177°C. Yield strengths, ultimate strengths, and C/sub V/ shelf energies are tabulated for irradiated and unirradiated material. The J/sub Ic/ toughness of the irradiated A533-B1 was determined to be 155 kJ/m^2 as compared o 349 kJ/m^2 prior to irradiation. The reduction in upper-shelf J/sub Ic/ toughness is thus approximately 55%; C/sub V/ energy on the upper shelf was reduced by only 13%. The quoted values should be considered as preliminary. 1 figure, 2 tables. (RWR)

50704 Surface erosions by energetic helium and hydrogen bombardment of molybdenum and pyrolytic graphite. Sone, K.; Saidoh, M.; Abe, T.; Yamada, R.; Obara, K.; Ohtsuka, H.; Murakami, Y. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). pp 375-378 of Proceedings of the seventh international vacuum congress and the third international conference on solid surfaces. Vol. 1. Dobrozemsky, R.; Ruedenauer, F.; Viehboeck, F.P.; Breth, A. (eds.). Vienna; Oesterr. Studiengesellschaft fuer Atomenergie G.m.b.H. (Sep 1977).

From 7. international Vac. congress and 3. international conference on solid surfaces; Vienna, Austria (12 Sep 1977).

Polycrystalline molybdenum with electropolished and roughened surfaces and mechanically polished pyrolytic graphite have been bombarded with 100 keV helium and 200 keV H_3^+ ions at room temperature. In electropolished molybdenum the critical fluences for blister formation were measured to be approximately 7.5 x 10^{17} and 2.5 x 10^{19} particles/cm^2 for helium and hydrogen bombardment, respectively. It was found than blistering caused by helium ion bombardment can be reduced or suppressed by roughening the electropolished molybdenum surfaces with emery paper. In pyrolytic graphite severer erosions advanced with the time elapsed.

CERAMICS, CERMETS, AND REFRACTORIES

50705 (COO—2390-34) **Basic research in crystalline and noncrystalline ceramic systems. Annual report, May 1, 1977—April 31, 1978.** (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1978. Contract EY-76-S-02-3490. 102p. Dep. NTIS, PC A06/MF A01.

Progress is reviewed for research in the following areas: electrical, optical, and dielectric properties of crystalline and noncrystalline ceramics; microstructure development during processing and evolution in service under various driving forces, and effects on properties; kinetic studies including factors affecting ion transport and diffusion; and defect interactions, solute distribution, grain boundary phenomena and influence on properties. (GHT)

50706 (FE—2664-7) **Ceramic technology readiness program. Seventh monthly technical progress report, April 3, 1978—April 30, 1978.** (AiResearch Mfg. Co. of Arizona, Phoenix (USA)). 10 May 1978. Contract EF-77-C-01-2664. 38p. Dep. NTIS, PC A03/MF A01.

Progress is reported on work performed to (1) provide convincing evidence of the ability of ceramic components to survive for lifetimes adequate for utility applications in an environment of high temperature combustion products from coal-derived fuels and, (2) to develop and demonstrate technology readiness for the application of ceramic materials technology to advanced gas turbines operating on coal-derived fuels in utility base load and intermediate load service. (GHT)

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 49617, 49639, 49640, 49643, 50390, 50532

50707 (RFP-Trans—243) **Manufacture of spherical pellets for applications in nuclear engineering.** May 1978. Translation of German Patent 2,517,153. 22p. Dep. NTIS, PC A02/MF A01.

An invention is described that concerns a method for manufacturing spherical pellets--which are suitable for applications in nuclear engineering--from ceramic materials, by introduction of liquid, organic phase components, from which essentially one or more actinide and/or lanthanide hydroxides are formed by solidification in an organic phase with low temperature, forming droplets which are then converted to solid pellets under the influence of an alkaline gelling agent, after which the resulting solid pellets are converted into a ceramic material by known processes, including slurrying with ammonia solution, drying and sintering. (GHT)

50708 Preparation of a beta-alumina ceramic for the sodium-sulfur battery using a chemical powder preparation method. Baukal, W.; Beck, H.P.; Kuhn, W.; Sieglen, R. (Battelle-Inst. E.V., Frankfurt am Main). pp 655-671 of Power source 6. Research and development in non-mechanical electrical power sources. Proceedings of the 10th international symposium held at Brighton, September 13-16 1976. Collins, D.H. (ed.). New York; Academic Press Inc. (1977).

From 10. symposium on research and development in non-mechanical electrical power sources; Brighton, UK (13 Sep 1976). See CONF-7609175—.

The process of thermal decomposition of an atomized nitrate solution proved to be applicable to the preparation of beta-alumina doped with magnesium oxide. The oxide powder prepared by this method leads to a ceramic with a microstructure superior to that of a conventionally prepared ceramic. The absence of coarse-grained crystallites may cause a longer lifetime of the ceramic in the sodium—sulfur battery. 10 figures, 4 tables.

STRUCTURE AND PHASE STUDIES

50709 Hysteresis effects at the semiconductor—metal phase transition in vanadium oxides. Lanskaya, T.G.; Merkulov, I.A.; Chudnovskii, F.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 2, 193-197(Feb 1978).

Hysteresis effects at the semiconductor—metal phase transition in vanadium oxides were investigated. It was found experimentally that these hysteresis effects were due not only to the martensitic nature of the transition, but also to activated processes observed in phase-transition interference light reflector (PILIR) films. The hysteresis effects at the phase transition were described by a distribution function of the values of the transition and coercivity temperatures of microscopic regions in a crystal. An experimental method for constructing this distribution function was developed. Analysis of the experimental results showed that fine-grained PILIR films were characterized by a wide range of the phase equilibrium T_0 and coercivity T/sub co/ temperatures (55 $<T_0<65^0$C, 6$<$T/sub co/ $<$12 °C). The problems of optical storage of information in single-crystal and fine-grained films are considered.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 50710

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 50280, 50399, 50540

50710 Uniaxial-stress effects in a 95/5 lead zirconate titanate ceramic. Fritz, I.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Appl. Phys.;* **49**: No. 9, 4922-4928(Sep 1978).

The response of a lead zirconate titanate ceramic to statically applied uniaxial stresses in the range 0—0.4 GPa has been investigated. The material studied was a niobium-doped composition with the chemical formula Pb/sub 0.99/Nb/sub 0.02/(Zr/sub 0.95/Ti/sub 0.05/)/sub 0.98/O_3. Properties measured as a function of stress include electrical charge release from poled specimens, ferroelectric hysteresis-loop behavior, macroscopic strains, and ultrasonic velocities. Data from the experiments exhibit anomalous behavior at low-stress levels (0.05—0.2 GPa). Comparison with similar data obtained under conditions of hydrostatic pressure indicate that the anomalies observed in the uniaxial-stress experiments are caused by domain-reorientation processes rather than by the ferroelectric to antiferroelectric phase transition. This transition occurs at 0.32 GPa under

hydrostatic-pressure conditions, but no evidence for it is seen in the uniaxial-stress measurements to 0.4 GPa. The relationship of the present results to other uniaxial-stress studies and to shock-wave studies on ferroelectric ceramics is discussed.

50711 Emissivity of stoichiometric zirconium carbide. Petrov, V.A.; Radzyukevich, T.E.; Soklov, V.V. (High-Temperature Institute, Academy of Sciences of the USSR). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 832-836(Mar 1978).

New experimental data are presented on the integral hemispherical emissivity and the monochromatic emissivity for wavelength 0.65 μ for both pure pyrolytic zirconium carbide of composition close to stoichiometric, and for stoichiometric zirconium carbide with small additions of nitrogen. It is shown that a nitrogen content of amount up to 1% has no appreciable influence on the emissivity. The experimental data obtained are compared with all data available in the literature, and from this comparison recommendations are made for the most reliable values of radiative characteristics at temperatures above 1200°K.

50712 Thermal conductivity and diffusivity of solid solutions of hafnium and tantalum monocarbides at high temperatures. Friedlender, B.A.; Zaitsev, G.P.; Neshpor, V.S.; Ordan'yan, S.S. (Leningrad). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 837-841(Mar 1978).

The thermal diffusivity of solid solutions of hafnium and tantalum monocarbides in the range 1000—2200°C was measured using the method of plane temperature waves. A generalized equation for the temperature—concentration dependence of the thermal diffusivity in this temperature region was obtained. The thermal conductivity of solid solutions of carbides of Hf and Ta was calculated using heat capacity data from various references. The electrical resistivity of these materials was measured using a compensation method on a constant current.

50713 Raman scattering investigation of structural transformations in solid solutions based on zirconium and hafnium dioxides. Aleksandrov, V.I.; Voron'ko, Y.K.; Ignat'ev, B.V.; Lomonova, E.E.; Osiko, V.V.; Sobol', A.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 2, 305-309(Feb 1978).

Raman scattering was used to study single crystals of solid solutions based on zirconium and hafnium dioxides containing various stabilizing impurities (Gd_2O_3, Y_2O_3, or Yb_2O_3). An analysis of the Raman spectra yielded the relation between the structure of the crystals and the concentration and type of the stabilizing impurity. The behavior of vibrational spectra in mixed crystals of this type is discussed.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 50085, 50128

50714 Effect of neutron irradiation on single-crystal V_3Si: Heat capacity and resistivity. Viswanathan, R.; Caton, R. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B;* **18**: No. 1, 15-21(1 Jul 1978).

We have measured the heat capacity and resistivity of a V_3Si single crystal as a function of neutron irradiation up to a fluence of 22.2 x 10^{18} n/cm^2. The structural transformation was found to be extremely sensitive to very-low-level irradiations ($\sim$ 0.25 x 10^{18} n/cm^2) whereas the superconducting transition temperature T/sub c/ was not affected up to $\sim$ 3 x 10^{18} n/cm^2. The residual resistivity showed minor variations up to $\sim$ 3 x 10^{18} n/cm^2 and started to change appreciably beyond that fluence. The electronic-heat-capacity coefficient and hence the density of states at the Fermi level was found to be considerably affected for all fluences. Further there is some evidence for the inhomogeneous nature of the irradiated state.

50715 Effect of neutron irradiation on single-crystal V_3Si: Neutron diffraction studies. Cox, D.E.; Tarvin, J.A. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B;* **18**: No. 1, 22-29(1 Jul 1978).

Elastic and inelastic neutron-diffraction measurements have been made on a single crystal of V_3Si as a function of fast-neutron irradiation. After irradiation to a fluence of 22.2 x 10^{18} n/cm^2 (E > 1 MeV), refinement of the Bragg intensity data reveals a slight decrease in the long-range-order parameter to a value of about 0.9, and an increase in the average value of the mean-square displacement $< u^2 >$ at low temperature of about 0.001 A^2. Inelastic-scattering measurements show that the softening of the transverse-acoustical mode associated with the martensitic transition is absent in the irradiated crystal.

COMPOSITE MATERIALS

PREPARATION AND FABRICATION

50716 (UCRL—13775(Suppl.)) **Influence of an oxide layer on the sintering of metals: The Pd—PdO system.** Higgins, P.K.; Munir, Z.A. (California Univ., Davis (USA)). 19 May 1978. Contract W-7405-ENG-48. 4p. Dep. NTIS, PC A02/MF A01.

The problem of sintering the palladium—palladium oxide system is investigated. The thermodynamics properties of the reactions 2Pd + O_2 → PdO are shown. The dissociation temperature for PdO (i.e., the temperature at which P/sub O_2/ = 1 atm) is 1163°K. When sintered at temperatures exceeding this value, palladium exhibits densification and conversely, at temperatures below this limit the sintering of palladium is not accompanied by shrinkage. The stability of the oxide as a function of P/sub O_2/ or the quality of the vacuum is discussed. 4 references. (JFP)

MECHANICAL PROPERTIES

50717 (BNWL-tr—316) **Damping capacity of Ni—SiO composite film materials.** Zolotukhin, I.V.; Il'inskii, A.I.; Kombarov, V.V.; Biletchenko, N.M.; Savchenko, I.A. Translated from *Fiz. Met. Metallored.;* **43**: No. 3, 654-657(1977). 9p. Dep. NTIS, PC A02/MF A01.

The damping capacity and structure of Ni-SiO composite materials were studied. The materials were produced by the successive vacuum condensation of alternating layers of Ni and SiO (multilayer condensates, or MLC) and the simultaneous condensation of two materials (dispersion-hardened condensates, or DHC). In MLC, the thickness of the nickel and silicon oxide layers was 0.6 and 0.25 μ respectively, with a total SiO content of 4 percent by volume. In DHC the particles with a maximum size up to 100 Angstrom were distributed uniformly in the nickel matrix. (GHT)

RADIATION EFFECTS

50718 (ORAU/IEA—78-2(R), pp 16-24) **Toxicology and dose-effect assessments.** Autian, J. (Univ. of Tennessee Center for Health Services, Memphis). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: inhalation of toxic gases after burning of polymeric material; carcinogenicity of saccharin; importance of reducing exposure to radiation and chemicals and of more knowledge of toxic properties of chemicals; factors to be considered in determining toxicity of new chemical agents; relation of dose to biological effects of compounds; calculation of LD_{50} dose; application of cancer data from animal experiments to humans; and high cost of establishing toxicological programs. (HLW)

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 50757

STRUCTURE AND PHASE STUDIES

50719 Ultrasonic observation of a strong pretransitional anomaly near a nematic—smectic-A phase transition. Bhattacharya, S.; Sarma, B.K.; Ketterson, J.B. (Department of Physics and Astronomy, and Materials Research Center, Northwestern University, Evanston, Illinois 60201). *Phys. Rev. Lett.;* **40**: No. 24, 1582-1586(12 Jun 1978).

Strong anomalies in the velocity and attenuation of longitudinal ultrasound in the megahertz range were observed for the first time in the vicinity of the nematic—smectic-A phase transition in a liquid crystal (terephthal-bis-p-p'-butylaniline). Results are in strong contradiction with theoretical predictions and are qualitatively consistent with a picture involving both critical fluctuations and relaxation of the smectic order parameter, similar to that observed near the λ transition in liquid helium.

PHYSICAL PROPERTIES

50720 (SAND—78-0412) **Room temperature moisture kinetics of Kevlar 49 fabric/epoxy laminates.** Allred, R.E.; Lindrose, A.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1978. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

Hydrothermal effects can significantly influence the failure behavior of high performance epoxy-based composites. As such, it is necessary to determine, for one, the moisture diffusion rates in the composite's principal axes so that moisture densities and distributions

can be estimated for life-cycle exposures. In this study, moisture diffusion coefficients are determined for quasi-isotropic Kevlar 49 181-style fabric reinforced Narmco 5208 epoxy laminates, and for the epoxy and fabric components individually. A microbalance technique is employed to continuously monitor the percentage weight gain of specimens exposed to 76 percent relative humidity at room temperature. The anisotropy of moisture diffusivity in the composite laminates is determined by use of a slope ratio (absorption vs time) technique and specimens of appropriate geometry. Results show that moisture diffuses in the laminate plane (6.1×10^{-8} cm²/sec) two orders of magnitude faster than through the thickness (1.7×10^{-10} cm²/sec). These values compare to a resin diffusivity of 6.5×10^{-10} cm²/sec. It is speculated that the rapid inplane diffusion is due to the preferential diffusion of moisture in the filament along its length.

50721 Origin of pyroelectricity in polyvinylidene fluoride. Kepler, R.G.; Anderson, R.A. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Appl. Phys.;* **49**: No. 9, 4918-4921(Sep 1978).

In order to determine the relative contribution of primary pyroelectricity and secondary pyroelectricity to the total pyroelectric coefficient of polyvinylidene fluoride, samples have been heated suddenly using a 200-ps laser pulse and the time dependence of the appearance of the pyroelectric charge measured. Charge resulting from primary pyroelectricity would appear as fast as the sample is heated, but charge resulting from secondary pyroelectricity would appear only as rapidly as the sample can relax to the new higher-temperature dimensions. The results indicate that no significant fraction of the pyroelectricity of polyvinylidene fluoride is primary pyroelectricity. It is suggested that a reversible temperature dependence of the crystallinity might provide an important contribution to pyroelectricity.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 50794

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 49345, 49776, 49777, 49779, 50401, 50662

50722 Plasma anodization of GaAs in a dc discharge. Chesler, L.A.; Robinson, G.Y. (Department of Electrical Engineering, University of Minnesota, Minneapolis, Minnesota 55455). *J. Vac. Sci. Technol.;* **15**: No. 4, 1525-1529(Jul 1978).

Thin oxide films have been grown by anodization of GaAs in the negative glow region of a dc oxygen discharge. As-grown and annealed films grown on both p- and n-type bulk GaAs were characterized by conventional electrical measurements and by Auger analysis. The anodic oxide displayed ohmic characteristics up to fields of 0.5×10^6 V/cm with a resistivity of 10^{14} Ω cm in the as-grown condition and over 10^{15} Ω cm after anneal. Capacitance—voltage measurements indicated a fixed positive charge in the insulator of 1.5×10^{12} cm^{-2} for p-type substrates and 4.0×10^{11} cm^{-2} for n-type substrates. Majority carrier trapping near the oxide/GaAs interface was reduced by annealing and a corresponding reduction of As at the interface was observed. The distribution of fast interface states on p-type substrates had a broad minimum of $7—10 \times 10^{11}$ cm^{-2} eV^{-1} near midgap while the distribution of fast interface states displayed a peak of over 10^{13} cm^{-2} eV^{-1} near midgap on n-type samples. No corresponding difference in the Auger composition profiles were observed between n- and p-type samples.

STRUCTURE AND PHASE STUDIES

50723 (LBL—7638) **Pore structure and growth kinetics in carbon materials.** Bose, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 86p. Dep. NTIS, PC A05/MF A01.

Thesis.

Pore structure of glassy carbon (GC) and pyrolytic graphite (PG) have been investigated. GC is one of the most impervious of solids finding applications in prosthetic devices and fuel cells while PG is used extensively in the aerospace industry. One third of the microstructure of GC consists of closed pores inaccessible to fluids. The microstructure of this material has been characterized using x-ray diffraction (XRD) and high resolution electron microscopy. Small angle x-ray scattering (SAXS) has been used to measure the angstrom sized pores and to follow the evolution of pore surface area as a function of heat treatment temperature (HTT) and heat treatment time (HTt) at constant temperature. From these measurements an analysis of the surface area kinetics was made to find out if rate processes are involved and to locate graphitization occurring at pore surfaces. PG on the other hand has been found to have larger sized pores that comprise five percent of its volume. In addition to being closed these pores are oriented. Some pore models are proposed for PG and the existing scattering theory from oriented ellipsoids is modified to include the proposed shapes.

50724 Raman scattering from condensed argon. Crawford, R.K.; Bruns, D.G.; Gallagher, D.A.; Klein, M.V. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *Phys. Rev., B;* **17**: No. 12, 4871-4883(15 Jun 1978).

Two-phonon Raman spectra have been measured for solid-argon samples at two densities at low temperature. These results are compared with published calculations based on a point-dipole model, and some shortcomings of this model are indicated. The development of the Raman spectra with increasing temperature in the solid at constant density has been studied, and the results discussed in the context of this model. Finally, spectra were measured for solid and fluid argon at a number of points along the melting curve at pressures up to 4 kbar, in order to explore the changes which occur upon melting. These results are compared with previously published data for fluid argon at other temperatures and pressures. Some comparisons with molecular-dynamics calculations are also made.

50725 Case of the phantom phases in solid hydrogen. Mills, R.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico). *J. Low Temp. Phys.;* **30**: No. 9, 423-439(1 May 1978).

Published measurements relating to the upper transition in solid hydrogen are reviewed and inconsistencies are pointed out. An attempt is made to connect this transition to the well-known one at low pressures and temperatures.

50726 Heat capacity anomalies associated with structural transformations in β-W and perovskite compounds. Viswanathan, R. (Brookhaven National Lab., Upton, NY); Ho, J.C. *Ferroelectrics;* **17**: 339-340(1977).

The similarity of the heat capacity anomalies, often observed with structural transformations driven by soft phonons, in both β-W and perovskite compounds is discussed referring to our recent work on V_3Si and $RbCaF_3$.

PROPERTIES

REFER ALSO TO CITATION(S) 49974, 50686, 50723

50727 (CONF-780301—, pp 258-275) **Dielectric properties for SF_6 and SF_6 mixtures predicted from basic data.** Kline, L.E.; Davies, D.K.; Chen, C.L.; Chantry, P.J. (Westinghouse Research and Development Center, Pittsburgh). May 1978.

From International conference on gaseous dielectrics; Knoxville, TN, USA (6 Mar 1978).

In Gaseous dielectrics.

α and eta, the ionization and attachment coefficients, and $(E/N)^*$, the limiting breakdown electric field-to-gas density ratio, in SF_6 and SF_6 mixtures were calculated by numerically solving the Boltzmann equation for the electron energy distribution. The calculations require a knowledge of several electron collision cross sections. Published momentum transfer and ionization cross sections for SF_6 were used. Various attachment cross sections for SF_6 were measured by using electron beam techniques with mass spectrometric ion detection. A total cross section for electronic excitation of SF_6 was determined by comparing the predicted values of α, eta, and $(E/N)^*$ with measured values obtained from spatial current growth experiments in SF_6 in uniform fields over an extended range of E/N. With this self-consistent set of SF_6 cross sections, together with published He cross sections, it was then possible to predict the dielectric properties of SF_6—He mixtures. Published experimental values of α for these mixtures lie between the values of α calculated with and without ionization of SF_6 by excited He atoms. Published experimental values of $(E/N)^*$ agree with the calculations to within 5%. 11 figures.

50728 (COO—4506-2) **New battery materials. Progress report, October 1, 1977—March 31, 1978.** Huggins, R.A. (Stanford Univ., Calif. (USA)). Apr 1978. Contract EC-77-S-02-4506. 24p. Dep. NTIS, PC A02/MF A01.

Ionic conductivities of solid solutions formed between Li_4SiO_4 and Li_2SO_4 have been measured. The conductivity of 0.7 Li_4SiO_4.0.3 Li_2SO_4 is comparable to the best lithium ion conductors previously found in other lithium silicate solid solution systems. At low Li_2SO_4 concentrations the solid solutions have the Li_4SiO_4 structure; from 30 to 50 m/o Li_2SO_4 the Li_3PO_4 structure is found. Other work on Li_4SiO_4 type electrolytes includes thermodynamic measurements on Li_5AlO_4, conductivity studies involving other dopant systems and the development of ac techniques for the study of the dependence of conductivity on microstructure. Very high lithium conductivities have been obtained in poly-crystalline samples of lithium nitride, the conductivities are comparable to those found

in single crystal samples. Work on the lithium-aluminum electrode system has been extended to include a detailed study of the kinetics of Li diffusion in the α-phase.

50729 (SAND—78-0058) **Technique for measuring PbS film reflectivity.** Davis, H.P.; Landry, M.J. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1978. Contract EY-76-C-04-0789. 13p. Dep. NTIS, PC A02/MF A01.

A technique is described to measure the internal reflectivity of modified right-angle prisms. One of the internal reflecting surfaces is altered by a vacuum-vapor-deposited lead sulfide film. The prisms were used in a Nd^{3+} glass laser as a cavity "Q" spoiling device. The removal of this film by ionization produced a self Q-switched laser pulse. All reflectivity measurements were made with a commercial spectrophotometer and specially designed optical mounts. Reflectivities were measured over a wavelength range from 800 to 2000 nm with prime interest at the losing wavelength 1060 nm. Resultant data at 1060 nm shows film reflectivity of the prism's glass-film interface decreasing with increasing evaporation time. Data also shows minimum reflectivity for a specific evaporation time with "P" oriented linearly polarized light, as compared to "S" orientation and elliptically polarized light. The optical mounts and measurement technique described provided valid reflectivity information in the self Q-switched laser experiment.

50730 (TR—22.2185) **Damage profiles in silicon and their impact on device reliability. Final report.** Schwuttke, G.H.; Yang, K.H. (International Business Machines Corp., Hopewell Junction, N.Y. (USA). East Fishkill Lab.). 1 Apr 1978. 152p. IBM Corp., Hopewell Junction, NY.

The principle of defect engineering is applied to GaAs substrates to produce epitaxial layers of low crystallographic defect density. Defect engineering is achieved through control of surface stresses in GaAs wafers during high temperature processing. Surface stress control is obtained through Impact Sound Stressing damage introduced on wafer backsides before epitaxial processing. Thus, epitaxial GaAs layers obtained through liquid phase epitaxy contain low dislocation numbers through confinement of threading dislocations to the epitaxial-substrate interface. A detailed analysis of ISS damage in GaAs before and after annealing is also given.

50731 Stress-wave propagation in Al_2O_3-epoxy mixtures. Munson, D.E.; Boade, R.R.; Schuler, K.W. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **49**: No. 9, 4797-4807(Sep 1978).

One-dimensional shock loading, attenuation, and recompression data from gas-gun experiments on mechanical mixtures of alumina powder and epoxy were used to develop model parameters for stress-wave propagation. Specimens with 0.42, 0.34, and 0.20 volume fractions of alumina were investigated. Calculations simulating the experiments were performed using an extension of a Maxwell rate-dependent model which requires definitions of the instantaneous, equilibrium, and relaxation functions as input. Experimental observations indicated the shock-loading behavior is identifiable with the equilibrium response, and the release wave behavior is closely related to the instantaneous response. To model these effects, for negative strain rates, indicative of expansion, a relaxation time of 0.25 μs was used; this value gave agreement between the calculated and measured release wave behavior. For positive strain rates, indicative of compression, the relaxation time was permitted to decrease to 0.03 μs, which caused the shock-loading response to be dominated by the equilibrium function. Hugoniot data determined from the stress-wave profiles were compared to effective modulus calculations. This comparison suggests a strength effect which can be interpreted as an interaction between the components. Analysis using a self-consistent scheme for spherical particles shows good correlation between calculated and measured ultrasonic and Hugoniot intercept wave velocities.

50732 Effect of temperature on the pressure dependence of helium solubility in vitreous silica. Shelby, J.E. (Sandia Laboratories, Livermore, California 94550). *J. Appl. Phys.;* **49**: No. 9, 4958-4960(Sep 1978).

Helium solubility in vitreous silica was measured from 100 to 1350 atm at 5, 25, 50, and 80 °C. The results can be described by the Langmuir adsorption isotherm at each temperature. The temperature dependence of the high-pressure helium solubility in this gas-glass system can be described either by the van't Hoff equation or by a statistical thermodynamical model.

50733 New phenomena in Schottky barrier formation on III—V compounds. Lindau, I.; Chye, P.W.; Garner, C.M.; Pianetta, P.; Su, C.Y.; Spicer, W.E. (Standord Electronics Laboratories and Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305). *J. Vac. Sci. Technol.;* **15**: No. 4, 1332-1339(Jul 1978).

The possibility of a defect mechanism is proposed to explain the Fermi-level pinning in Schottky barriers on III—V semiconductor surfaces. This suggestion comes from the results of photoemission spectroscopy applied to the study of formation of metal—semiconductor barrier heights. Changes in the electronic structure and composition of the interface are studied. For Au metal overlayers on the (110) surfaces of GaAs, GaSb, and InP, the Fermi-level pinning occurs at 0.1 or less of a monolayer coverage. Furthermore, the pinning position is roughly independent of the choice of adatom: Cs, Al, Au, or O. The partial yield structure disappears at about monolayer coverage of Au. The Au valence band had the characteristic shape for atomiclike Au, indicating that the metal was dispersed homogeneously on the surface without the formation of thick islands. Deposition of Au onto the GaSb surface causes the compound to decompose. The antimony segregates to the surface and leaves behind a nonstoichiometric interface. The results for GaSb are compared to those for GaAs(110) and InP(110), where removal takes place of both semiconductor constituents in the interface.

50734 Theoretical trends in the abrupt (110) AlAs—GaAs, Ge—GaAs, and Ge—ZnSe interfaces. Pickett, W.E.; Cohen, M.L. (Department of Physics, University of California). *J. Vac. Sci. Technol.;* **15**: No. 4, 1437-1443(Jul 1978).

The self-consistent pseudopotential method has been applied to describe the electronic structure of the abrupt (110) interfaces of AlAs—GaAs, Ge—GaAs, and Ge—ZnSe system. These systems were chosen both for their technological interest as well as to study trends with ionicity. The method allows the study of existence, character, and density of interface states as well as allowing estimates of the conduction and valence-band discontinuities and the characterization of the bonding properties of the interface. The results indicate that the ideal structure may be stable for AlAs—GaAs, but the character of the bonds at the Ge—GaAs and Ge—ZnSe interfaces suggest unbalanced forces on the atoms which will lead to relaxation. It is suggested that, in addition to the change of ionicity, the change of crystal symmetry (diamond—zincblende) across the interface may be of central importance in these systems.

50735 Low-temperature specific heat of $K_2Pt(CN)_4Br$/sub 0.3/ x$3H_2O$. Taylor, W.A.; Saillant, R.; Gerstein, B.C. (Ames Laboratory, U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Phys. Rev., B;* **17**: No. 12, 4705-4709(15 Jun 1978).

The molar heat capacity of $K_2Pt(CN)_4Br$/sub 0.3/ x $3H_2O$ is reported for the temperature range 0.75—25.7 K. Results of a least-squares fit to data in the range 1.5—6 K include a coefficient for the linear temperature contribution of 2.12 mJ/mole K^2 and a Debye temperature of 273 K. Higher-order terms were required to fit the data in this range. Possible sources for the linear contribution are those associated with one-dimensional lattice vibrations and/or spin and charge degrees of freedom of a one-dimensional degenerate Fermi gas.

50736 Tunneling-recombination luminescence between Ag^0 and Ag^{2+} in KCl:AgCl. Delbecq, C.J.; Dexter, D.L.; Yuster, P.H. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B;* **17**: No. 12, 4765-4774(15 Jun 1978).

Appropriate treatment of a KCl:AgCl crystal results in the trapping of electrons as silver atoms, Ag^0, and positive holes as $AgCl_4^{2-}$, Ag^{2+}, centers. Optical excitation of Ag^0 in such a crystal at $T < 90$ K produces a luminescence which lasts for many hours after the excitation. Evidence is presented which indicates that this afterglow results from electron-hole tunneling recombination between nearby Ag^0 and Ag^{2+} pairs, similar to the Ag^0-Cl_2- tunneling-recombination studies we previously reported. We have shown that Ag^{2+} centers are involved in the emission process by preferentially orienting the anisotropic Ag^{2+} at 6 K by excitation with polarized light and observing that the afterglow is polarized. Upon warming to 50 K, where the preferentially oriented Ag^{2+} can change orientation, a strong reversal in the degree of polarization occurs which finally decays to zero. The characteristics of this luminescence can be understood if we assume: (i) a tunneling-recombination mechanism in which the orientation of the electric vector of the emitted radiation depends on the position of the Ag^0 relative to the Ag^{2+} and (ii) the tunneling is anisotropic and depends on the location of the Ag^0 relative to the anisotropic Ag^{2+}. The latter assumption is based on the tetragonal (d-like) symmetry of the Ag^{2+} complex. Good quantitative agreement between theory and experiment has been obtained on the decay kinetics, the degree of polarization, and the polarization reversal.

50737 Neutron-diffraction study of Zr(Ca,Y)O/sub 2-x/: Evidence of differing mechanisms for internal and external distortions. Faber, J. Jr.; Mueller, M.H.; Cooper, B.R. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B;* **17**: No. 12, 4884-4888(15 Jun 1978).

We have deduced from measurements of the neutron elastic cross section that below the order-disorder transition in Zr(Ca)O/sub 2-x/ and Zr(Y)O/sub 2-x/ the oxygen atoms are shifted from their fluorite positions. We find quantitative agreement with experi-

ment for a model containing a rearrangement (internal shear deformation with amplitude 0.23 A) of the oxygen sublattice. The (110) internal shear deformation is the same (in symmetry and magnitude) for Zr(Ca)O/sub 2-x/ and Zr(Y)O/sub 2-x/, however, only Zr(Y)0/sub 2-x/ exhibits an external distortion. These observations are consistent with the fact that the internal rearrangement is an inhomogeneous deformation and does not require the presence of an external strain. A successful test of Cooper's search criterion leads us to an internal rearrangement mode corresponding to a $q = (0,0,2\pi/a)$ longitudinal phonon, and points to the dominance of cation-anion interactions in determining the nature of the lattice internal rearrangement.

50738 Vapor-deposited metal—Gas alloys of sodium and ammonia. McNeal, N.A.; Goldman, A.M. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota). *J. Low Temp. Phys.;* **30**: No. 11, 863-885(1 Jun 1978).

Films of sodium and ammonia were formed directly from vapor onto substrates held at or below 5 K. The electrical resistivity of the films was measured as a function of sodium concentration. A Metal—nonmetal transition as a function of composition was observed at concentrations in the 45—50 mole % range. The transition was found to be anomalous in that the resistivity was not a monotonic function of the sodium concentration. The data indicate that there is enhanced conductivity over a narrow concentration range on the nonmetal side of the transition. The conductivity is not magnetic field dependent up to the maximum available field of 4 kOe. No evidence was found for the anomalous electrical conductivity previously reported for bulk, dilute sodium—ammonia solids that were quick-frozen from liquid solutions.

50739 Effect of fractional composition on the thermal conductivity of carbon charges in vacuum. Lutkov, A.I.; Mikhailov, B.N. (Moscow). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 850-853(Mar 1978).

A steady radial heat-flow method was used to measure the thermal conductivity of dispersed KNPS coke having various particle sizes and of natural graphite of the Zaval'evskii deposit in the range 100—700°C in vacuum. A criterion is selected and an empirical equation is proposed for describing the experimental data.

50740 Determination of the nonlinear optical coefficient and SHG coherence length for crystal single zinc selenide. Piltch, M.S.; Eckhardt, R.; Hinsley, R. (Los Alamos Scientific Lab., NM). *Opt. Commun.;* **22**: No. 2, 239-242(Aug 1977).

Zinc selenide is characterized by very low infrared absorption and a high threshold for optical damage making its use as high power laser windows almost universal. Since the material is a member of the anti 43 m (zinc-blende) crystal class, it possesses a second order electric susceptibility tensor. We have measured the absolute value of the tensor components by the method of second harmonic generation of 10.6 micrometer radiation using a properly oriented single crystal wedge. Furthermore, the coherence length for the second harmonic process was accurately determined for various CO_2 laser lines. The results of the susceptibility measurement are compared to the results of Miller's phenomenological analysis while the coherence length measurements are compared to that quantity derived from previously available refractive index data.

50741 (BNWL-tr—313) **Atomic diffusion of lithium in the amorphous metallic alloy Pd—Si.** Birac, C.; Lesueur, D. Translated by C. Sample from *Phys. Status Solidi (a);* **36**: No. 1, 247-251(1976). 8p. Dep. NTIS, PC A02/MF A01.

The diffusion coefficient of lithium is measured in an amorphous metallic alloy $Pd_{80}Si_{20}$ obtained by rapid quenching from the melt. These measurements are preformed from 240 up to 290°C. The diffusion coefficient lies in the range 6×10^{-14} to 2×10^{-16} cm^2s^{-1}. It does not follow an Arrhenius law contrary to the case of diffusion of Ag in the same alloy. Moreover lithium diffusion is at least 10^2 times faster in the amorphous alloy than in the same crystalline alloy.

50742 (LA-tr—78-44) **Realization of multi-layers of multi-dielectric thin films in the 1700 to 2500 A band.** Malherbe, A. Translated from *Nouv. Rev. Opt. Appl.;* **2**: 337-344(1971). 19p. Dep. NTIS, PC A02/MF A01.

Different materials suitable for use in the 1700 to 2500 A wavelength band are presented. A theoretical study was carried out beginning with rough measurement indices. Experimental results are presented, in particular: selective mirrors and narrow band interference filters.

RADIATION EFFECTS

50743 Radiation damage in neutron transmutation doped silicon: Electrical property studies. Young, R.T.; Cleland, J.W.; Wood, R.F.; Abraham, M.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Appl. Phys.;* **49**: No. 9, 4752-4760(Sep 1978).

Radiation damage in neutron-transmutation-doped (NTD) silicon, irradiated to introduce 5×10^{13} to 6×10^{16} phosphorus cm^{-3}, has been studied by electrical property measurements. The experimental results indicate that thermal-neutron-induced (n,γ) recoil-type damage can be annealed at 400 °C. The nature of any remaining lattice defects and their annealing behavior above 400 °C is a function of the fast-neutron fluence. Small defect clusters are present in Si irradiated with a light-to-moderate fast-neutron fluence ($<$ or $=5 \times 10^{18}$ n cm^{-2}), and temperature-dependent Hall coefficient measurements indicate that at least two deep acceptor levels and one deep donor level are formed during annealing. One of these acceptor levels anneals at ~450 °C, and the other two levels anneal at ~550 °C. A shallow acceptor level near the valence band that anneals at 750 °C is also observed. Larger defect clusters which reduce the electron mobility tremendously and distort the band structure are formed in heavily irradiated Si (5×10^{18} to 10^{20} n cm^{-2}). Virtually all of the electrically detectable radiation damage in NTD Si irradiated with a fast-neutron fluence up to 10^{20} n cm^{-2} can be removed by annealing at 750 °C for 1/2 h. There is some indication that a minority-carrier-recombination effect remains even after such annealing.

50744 Annealing of radiation damage in graphite. Primak, W. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Appl. Phys.;* **49**: No. 9, 4761-4764(Sep 1978).

It is shown from step annealing data for the 002 x-ray diffraction peak that the processes annealing below 200 °C possess a frequency factor ~10^{14} sec^{-1}, while those processes annealing at higher temperatures possess much lower frequency factors. This is attributed to the lower-temperature processes being associated with the movement of single carbon interstitial atoms and the higher-temperature processes being associated with more complex configurations, including clusters of carbon atoms.

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

50745 Determination of the concentration of carbon monoxide. Nischik, H.; Sturm, F. v. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,454,285/A/. 26 May 1976. 15p. (In German).

A method is described to determine the concentration of carbon monoxide by determining the degree of inhibition of a cathodic oxygen reduction caused by carbon monoxide. The change of electrical current strength with constant electrode potential due to the inhibition is used as measure for the carbon monoxide concentration. Carbon monoxide containing gas and a comparative gas produced by removing the carbon monoxide from the gas containing carbon monoxide are alternately led to the electrode.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 49856

50746 (LA-UR—78-1444) **More accurate thermal neutron coincidence counting technique.** Baron, N. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 22p. (CONF-780215—3). Dep. NTIS, PC A02/MF A01.

From Conference on NDE in the nuclear industry; Salt Lake City, UT, USA (13 Feb 1978).

Using passive thermal neutron coincidence counting techniques, the accuracy of nondestructive assays of fertile material can be improved significantly using a two-ring detector. It was shown how the use of a function of the coincidence count rate ring-ratio can provide a detector response rate that is independent of variations in neutron detection efficiency caused by varying sample moderation. Furthermore, the correction for multiplication caused by SF- and (α,n)-neutrons is shown to be separable into the product of a function of the effective mass of ^{240}Pu (plutonium correction) and a function of the (α,n) reaction probability (matrix correction). The matrix correction is described by a function of the singles count rate ring-ratio. This correction factor is empirically observed to be identical for any combination of PuO_2 powder and matrix materials SiO_2 and MgO because of the similar relation of the (α,n)-Q value and (α,n)-reaction cross section among these matrix nuclei. However the matrix correction expression is expected to be different for matrix materials such as Na, Al, and/or Li. Nevertheless, it should be recognized that for comparison measurements among samples of similar matrix content, it is expected that some function of the singles count rate ring-ratio can be defined to account for variations in the matrix correction due to differences in the intimacy of mixture among the samples. Furthermore the magnitude of this singles count

rate ring-ratio serves to identify the contaminant generating the (α,n)-neutrons. Such information is useful in process control.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 50983, 51093

50747 (GEPP—344) **Determination of percent carbonate in calcium chromate and barium chromate.** Middleton, H.W. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 15 May 1978. Contract EY-76-C-04-0656. 16p. Dep. NTIS, PC A02/MF A01.

The chemical characterization of calcium chromate and barium chromate required measuring the percent carbonate as an impurity. With a Knorr Alkalimeter apparatus, a procedure was developed using adaptations of the ASTM D-2352 and the Association of Official Analytical Chemists' methods. Fifty-six calcium chromate and nine barium chromate analyses were completed. The precision of the Knorr Alkalimeter method was determined from quadruplicate determinations of percent CO_2 on four different chromate samples. Accuracy was determined by measuring the percent CO_2 recovered from quadruplicate determinations of a 99.9 percent pure calcium carbonate. The Knorr Alkalimeter apparatus requires a relatively small bench area and is therefore convenient to use. Evaluation of the precision of the Knorr Alkalimeter method yielded a relative standard deviation of +- 5 percent for samples containing more than 0.01 percent CO_2. Accuracy of the method was checked by measuring the percent CO_2 recovered from four samples of pure $CaCO_3$; a recovery of 99.7 percent was obtained.

50748 (UCRL-Trans—11378) **Potentiometric determination of a mixture of primary, secondary, and tertiary amines.** Cosofret, V.V.; Stefanescu, C. Translated from *Rev. Chim. (Bucharest);* **28**: No. 7, 677-681(1977). 15p. Dep. NTIS, PC A02/MF A01.

A simple, rapid, and accurate potentiometric method for the determination of primary, secondary and tertiary aliphatic amine mixtures is described. The potentiometric titrations were carried out in acetonitrile as solvent using perchloric acid in acetonitrile as titrant. The method has the advantage that only two potentiometric titrations are necessary for the determination of mixtures of primary, secondary, and tertiary amines. The aromatic amines do not interfere in the determination of aliphatic amines.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 49413, 50948, 51331

50749 (NVO—178, pp 545-574) **Historical review of transuranic analytical methodology.** Wessman, R.A.; Leventhal, L. (LFE Environmental Analysis Labs., Richmond, CA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

The methods used for the analysis of the transuranic elements neptunium, plutonium, americium, and curium are reviewed. Particular attention is given to those procedures suitable for low-level environmental and biological assessment. The preparation of such samples, derived from a variety of sources and incorporated in different masses and volumes of soils, water, vegetation, and biological matrices, is described. A comprehensive discussion of matrix dissolution and equilibration techniques indicates that complete dissolution employing tracer techniques is to be preferred. Leaching of large soil samples is satisfactory for worldwide fallout. Individual and sequential separation and purification procedures, including precipitation, extraction, and ion exchange methods, are described. Sample preparation techniques for radiometric assay, such as stippling, evaporation, and plating, are reviewed. For both tracer and nuclide assay, electroplating provides the thin samples suitable for alpha pulse height analysis. Past and current counting methods for the transuranic alpha, beta, and gamma emitters are reviewed.

50750 **Proton microprobe: a powerful tool for nondestructive trace element analysis.** Bosch, F. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Goresy, A.E.; Martin, B.; Povh, B.; Nobiling, R.; Schwalm, D.; Traxel, K. *Science;* **199**: No. 4330, 765-768(17 Feb 1978).

A proton microprobe capable of focusing proton beams with energies up to 6 million electron volts to a spot size of 2 x 2 square micrometers was used for chemical analysis of small grains of minerals in lunar samples by proton-induced x-ray emission. The proton microprobe is preferable to the electron microprobe for analyzing trace elements whose concentrations are below the detection limit of the latter and for analyzing objects with numerous major and trace elements with a wide range of atomic numbers. Application of the proton microprobe to biological samples is feasible.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 50954, 51133, 51321

50751 (CONF-770478—P1, pp 493-494) **Use of near infrared/red radiance ratios for estimating vegetation biomass and physiological status.** Tucker, C.J. (Goddard Space Flight Center, Greenbelt, MD). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

50752 (UCRL—52407) **Computer-automated total organic carbon analyzer: operating instructions and computer documentation.** Rigdon, L.P.; Barton, G.W.; Fisher, E.R.; Taber, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1978. Contract W-7405-ENG-48. 98p. Dep. NTIS, PC A05/MF A01.

Lawrence Livermore Laboratory (LLL) has designed and installed a computer automation system for a total organic carbon (TOC) analyzer at two U.S. Environmental Protection Agency laboratories in Cincinnati, Ohio--the Environmental Monitoring and Surveillance Laboratory, and the Municipal Environmental Research Laboratory. This document gives operating instructions for the system and describes the computer programs and hardware used. The automation system was designed for use with the Beckman Model 915 TOC analyzer. The programs execute on a Data General NOVA-840 computer operating on multi-user BASIC language under Data General's MRDOS operating system. With appropriate changes the automation system could also operate with other similar carbon analyzers and other software operating systems. In the Beckman 915 TOC analyzer, organic carbon contained in a water sample is injected by a syringe through a septum into a combustion furnace. The oxygen carrier gas with the aid of a catalyst oxidizes all the carbon to carbon dioxide. The water vapor is condensed and trapped out of the flowing stream, which then passes into an infrared measurement cell and finally is exhausted. The infrared detector generates a signal proportional to the carbon dioxide concentration, which in conventional systems is plotted on a strip-chart recorder. The concentration of organic carbon in the sample is calculated by comparing the recorded signal from the sample with the signal from the same volume of a standard solution containing a known amount of carbon.

50753 **Interlaboratory comparisons of nickel analyses in urine by atomic absorption spectrometry.** Adams, D.B. (INCO Europe Ltd., Swansea, Eng.); Brown, S.S.; Sunderman, F.W. Jr.; Zachariasen, H. *Clin. Chem.;* **24**: No. 6, 862-867(Jun 1978).

From IUPAC symposium on clincial chemistry and chemical toxicology of metals; Monte Carlo, Monaco (4 Mar 1977).

Two interlaboratory surveys of urine nickel analyses were performed in which eight or nine urine samples were distributed to laboratories in seven nations for measurements of nickel concentrations by atomic absorption spectrometry. In both surveys, wide discrepancies were observed in the values for urine nickel concentrations that were obtained in different laboratories by various analytical methods. This finding documents a serious need for improvement in the proficiency of nickel analyses. Nonetheless, excellent interlaboratory concordance was found in the rankings of urine samples in order of increasing nickel concentrations. Analytical techniques that involved preliminary wet or dry ashing and extraction steps before flameless atomic absorption spectrometry were generally superior to techniques for direct analysis of urine by flameless atomic absorption spectrometry in respect to (a) analytical sensitivity, (b) recovery of added nickel, (c) interlaboratory precision, and (d) interlaboratory concordance of ranking of urine samples in order of increasing nickel concentrations.

50754 **Modified nebulizer for inductively coupled plasma spectrometry.** Donohue, D.L.; Carter, J.A. (Oak Ridge National Lab., TN). *Anal. Chem.;* **50**: No. 4, 686-687(Apr 1978).

This modified cross flow nebulizer design has been shown to offer simple and rugged operation, with the capability for precise positioning of the glass needles. The nebulizer requires less machine work than other designs and should be less expensive to manufacture. The absence of metals in the design provides a measure of safety from corrosion by highly acidic samples. And, the multiple sampling capability may prove useful in specialized areas of analysis, particularly with the more volatile organic liquids such as acetone or gasoline, which may be analyzed using water as the second liquid to initially stabilize the plasma by forming the axial channel; followed by gradual introduction of the organic sample and subsequent reduction of the water uptake rate. Another area of application might be in the selection of analytical emission lines for an unknown. With the sample being aspirated, the auxiliary needle could be used to introduce a standard solution of the desired elements in order to study spectral interference effects at a particular wavelength. Inexpensive

and more convenient aqueous standards could be introduced through the auxiliary needle to locate and evaluate spectral lines. A disadvantage of the dual sampling scheme is that the precision is degraded by a factor of 2 compared to single sample aspiration.

50755 Matrix modification for the determination of bismuth by flameless atomic absorption. Gladney, E.S. (Los Alamos Scientific Lab., NM). *At. Absorpt. Newsl.;* **16**: No. 4, 114-116(1977).

Ni additions were investigated for stabilizing Bi in the furnace during charring. Without Ni, there was a very rapid loss of signal above 600°C; with Ni, good sensitivity was achieved up to 1200°C charring temperature. The standard addition method showed good internal agreement. The detection limit for Bi appears to be below 1 ppB with +- 10 percent precision above 10 ppB. (DLC)

50756 Qualitative analysis by photoacoustic spectroscopy of amorphous uranium tetrafluoride deposits. Eaton, H.E.; Anton, D.R.; Stuart, J.D. (Univ. of Connecticut, Storrs). *Spectrosc. Lett.;* **10**: No. 10, 847-851(1977).

Photoacoustic spectroscopy is used to identify UF_4 in the reaction products resulting from uranium plasma studies. (DLC)

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 49378, 49652, 50749, 50990

50757 Open-pore polyurethane columns for collection and preconcentration of polynuclear aromatic hydrocarbons from water. Navratil, J.D. (Atomics International Div., Golden, Co.); Sievers, R.E.; Walton, H.F. *Anal. Chem.;* **49**: No. 14, 2260-2263(Dec 1977).

Open-pore polyurethane (OPP) columns are prepared by in-situ polymerization of toluene-carbon tetrachloride solutions of an isocyanate and a polyol. Columns of OPP have been tested for ion-exchange properties, solvent compatibilities, and ability to remove and concentrate polynuclear aromatic hydrocarbons (PAH) from water. Solutions containing 1 μg of pyrene per liter of water have been concentrated 200-fold by passing 1000 mL through a 0.3 x 5 cm column and eluting the pyrene with 5 mL of methanol. Recovery of pyrene was approximately 100%. Results of comparisons of breakthrough capacities and elution rates for PAH on OPP, Amberlite XAD-2, and Bio-Rad AG MP-50 are presented. 1 figure, 7 tables.

50758 Comparison of methods for hydrocarbon analysis of marine biota. Gritz, R.L.; Shaw, D.G. (Univ. of Alaska, Fairbanks). *Bull. Environ. Contam. Toxicol.;* **17**: No. 4, 408-415(Apr 1977).

A comparison was made of several procedures for the isolation of hydrocarbons from other matter and for the fractionation of hydrocarbons according to chemical type. The efficiency of Soxhlet extraction followed by saponification with extraction by alkaline digestion (direct saponification) was compared using two hour and 24 hour reaction times. All procedures were performed on approximately 60 g of soft parts of Saxidomus gigantea (butter clam). The 24 hour saponification and column chromatography on partially deactivated columns constituted the best procedure tested. Soxhlet extraction followed by two hour saponification did not completely remove methyl esters and was the most laborious technique. Direct two hour saponification was also questionable in the removal of esters and led to severe emulsion problems. The recoveries of hydrocarbons by the three procedures was substantially the same.

50759 Process for purifying gases containing sulfur dioxide. Renault, P.; Deschamps, A.; Franckowiak, S.; Dezael, C. (to Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). German(FRG) Patent 2,615,307/A/. 21 Oct 1976. 21p. (In German).

A method is described for the purification of a sulphur-dioxide-containing gas. One wastes the gas with an aqueous solution of ammonia and/or ammonium sulphite and separates the gas off from the resulting solution whose ammonium sulphite concentration has increased. At least part of the sulphite is decomposed by heating and a gas flow is produced containing SO_2, NH_3 and steam. In a further section one reacts H_2S with the gas flow in order to produce elementary S and a gas containing NH_3 and steam and non-converted hydrogen sulphide. The elementary sulphur is separated off, the ammonia recycled. The gas obtained is subjected to a gentle oxidation prior to being recycled, so that selective conversion of H_2S into SO_2 is possible.

50760 Separation of methane and lower alkenes with molecular-sieve membranes. Wolf, F.; Hentschel, W.; Krell, E. (Univ. Halle-Wittenberg, Leipzig). *Z. Chem.;* **16**: No. 3, 107-108(1976). (In German).

Heterogeneous membranes consisting of 55 to 75 percent of molecular sieve bound with a copolymer of polyethylene plus 6 percent of poly(vinyl acetate) were prepared. The efficiency of separation of binary mixtures (one component being CH_4) in comparison with four-component mixtures (CH_4 plus ethylene, propene and butene) was investigated. Generally, permeation of the alkenes (which are more soluble in the copolymer and undergo little exchange) in the narrower-pored sieves (into the pores of which they are unable to penetrate) was faster than that of CH_4. Only if the pores were sufficiently large did the greater affinity of the alkenes for the molecular sieve predominate to an extent such that CH_4 was concentrated in the permeating gas.

INORGANIC AND PHYSICAL CHEMISTRY

50761 Ionen in nichtwaessrigen Loesungen. (Ions in nonaqueous solutions). Barthel, J. (Regensburg Univ. (Germany, F.R.). Fachbereich Chemie). Darmstadt, Germany, F.R.; Steinkopff (1976). 176p. (In German).

The book shows the results of the problems involved taking account of chemical models which only conditionally correspond to the ideal model concepts of the continuum theory, but which often make use of it. The presentation of the theoretical fundamentals is limited to a necessary minimum. The fundamentals of electrolyte solution, thermodynamic properties of non-aqueous electrolyte solutions, electrolyte conductivity, dielectrical properties, reactivity of ions and ion associates as well as the ion association are discussed. Experimental procedures for measuring under inert gas atmospheres are described for all fields dealt with in this monography.

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 50382, 50976

50762 (COO—3129-44) **Experimental chemical kinetics: a study of chemical reactions by means of molecular beam techniques. Final report.** Greene, E.F. (Brown Univ., Providence, R.I. (USA)). May 1978. Contract EY-76-S-02-3129. 10p. Dep. NTIS, PC A02/MF A01.

A brief summary is given of the research conducted over 19 years on chemical reactions, using molecular beams. Thirty-seven published papers reporting the results in more detail are listed. (DLC)

50763 (TID—28437) **Experimental studies of the high temperature gas-solid-reaction system $MgO + Cl_2 \rightarrow MgCl_2 + O_2$.** Smith, C.S. (Florida Univ., Gainesville (USA)). 15 Oct 1977. Contract EY-76-S-05-4945. 28p. Dep. NTIS, PC A03/MF A01.

The weight monitoring method was used to study the noncatalytic solid-gas reaction $MgO + Cl_2 \rightarrow MgCl_2 + {}^1/_2O_2$, which can be used in thermochemical hydrogen production. Eight runs were attempted at 650°C and 5 in./s chlorine flow rate; the MgO was in the form of porous pellets. The chlorination proceeded rapidly initially, then slowed down at low conversions (approximately 15%). 5 figs. (DLC)

50764 Vapor pressure measurements, thermodynamic parameters, and phase diagram for the system potassium oxide—silicon oxide at high temperatures. Eliezer, N.; Howald, R.A.; Marinkovic, M.; Eliezer, I. (Montana State Univ., Bozeman). *J. Phys. Chem.;* **82**: No. 9, 1021-1026(4 May 1978).

Potassium oxide vaporizes from solutions in SiO_2 primarily according to the equation: $KO_{0.5}(l) \rightarrow K(g) + {}^1/_4O_2(g)$ (1). We have studied this equilibrium using atomic absorption in a constant temperature graphite furnace to measure the absorbance of the steady-state distribution of potassium atoms. The potassium atoms were introduced at the center of the furnace by diffusion through an orifice in sample cells which we developed for vapor pressure measurement. We have shown both experimentally and theoretically that, at a particular temperature, the absorbance we measure is proportional to the rate of diffusion of potassium atoms from the vapor pressure sample cells. For a particular cell with a particular orifice, there is a temperature-dependent conversion factor between absorbance and pressure which we evaluated from measurements with potassium aluminate standards in the cells. The pressure of potassium atoms was measured over a sufficient range of temperature to obtain the heat of vaporization. The Redlich-Kister coefficients for the enthalpy of mixing of liquid $KO_{0.5}$ and SiO_2 (A = -86, B = -53 kcal mol^{-1}) were obtained from this data and estimates for the thermodynamic properties of $KO_{0.5}$ (liquid), literature data on the enthalpy of glasses, the temperature dependence of rate of vaporization, and the variation of the activity of SiO_2 with temperature. Redlich-Kister coefficients for log γ/sub KO/sub 0.5// were obtained from the concentration dependence of the vapor pressure of potassium over the $KO_{0.5}$-SiO_2 samples: A = -10.9923, B = -6.7801, and C = -1.0101 at 1500 K. From these values, together with the enthalpy coefficients above, activities of both $KO_{0.5}$ and SiO_2 can be calculated over a wide range of temperatures and compositions. The $KO_{0.5}$-SiO_2 phase diagram was calculated from these values. Thermodynamic quantities are given for tridymite and for two potassium silicates, $K_2Si_4O_9$ and $K_2Si_2O_5$.

50765 Effect of molecular geometry on the electron affinity of water. Chipman, D.M. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **82**: No. 9, 1080-1083(4 May 1978).

Using self-consistent-field molecular orbital methods with inclusion of diffuse atomic orbitals in the basis set, the potential energy surfaces of H_2O and H_2O^- gas-phase monomers have been studied as the HOH bond angle varies from 30 to 180° and as one OH bond length is stretched from its equilibrium value by up to 0.3 A. The potential surface of H_2O^- was found to be very close to that of H_2O at all points studied. In particular, the H_2O^- surface showed no local minima other than the absolute minimum which occurs at the same geometry as the minimum of the H_2O surface. H_2O^- is calculated to be slightly stable with respect to vertical electron detachment at geometries with an HOH bond angle of less than about 95° or at any angle if one OH bond length is stretched sufficiently. However, the calculated binding energy of the excess electron is so small in the Franck-Condon region (a maximum of about 10^{-4} eV) that calcuations not invoking the Born-Oppenheimer approximation would be required to determine whether H_2O^- is truly a stable species.

50766 Surface tension of $TlNO_3$ and the binary mixtures $TlNO_3$—$LiNO_3$ and $TlNO_3$—KNO_3. Nissen, D.A. (Sandia Labs., Albuquerque, NM). *J. Chem. Eng. Data;* **22**: No. 4, 389-391(Oct 1977).

The surface tension of molten $TlNO_3$ has been measured over the temperature range 220-350 °C, using the maximum bubble pressure method. We have also measured the surface tension of the binary mixtures $TlNO_3$-$LiNO_3$ and $TlNO_3$-KNO_3 at 350 °C over the entire composition range. 3 tables, 2 figures.

50767 Adsorption of sulfur vapor on AG-5 active carbon. Lazarev, V.I.; Kisarov, V.M.; Yasikova, L.A. *J. Appl. Chem. USSR (Engl. Transl.);* **50**: No. 10, 2256-2257(Oct 1977).

Translated from Zh. Prikl. Khim.; 50: No. 10, 2364-2366(Oct 1977).

For the design of purification plants for the removal of S, H_2S, and SO_2 vapors from waste gases from the sulfur industry, data is needed on the capacity of activated carbon for S vapor. Experiments were conducted at 115 to 190°C. The limiting sulfur adsorption increases from 0.5% at 115°C to 19.5% at 190°C. The 150°C isotherm fits an equation with constants A = 8.33%, n = 1.85, and B = 5.35. (DLC)

50768 Procedure for fabricating spherical catalysts containing aluminia. Kuhrt, W.; Weidenbach, G.; Fischer, H.; Schindler, H. (to Kali-Chemie A.G., Hannover (Germany, F.R.)). German(FRG) Patent 2,546,318/A/. 28 Apr 1977. 16p. (In German).

A method for the production of spherical alumina catalysts by mixing an aluminium oxide hydrosol to which alumina and/or alumina hydrate and difficultly water-soluble compounds of catalytically active metals were added, with a thermal hydrolyzable base and by dropping or spraying the mixture into a liquid not mixable with water: The liquid temperature is 60° to 100°C; ageing of the gel particles formed in the water-non-mixable liquid at precipitation temperatures and then in aqueous ammonia solution, water washing followed by drying and calcination. High molecular organic natural substances which are insoluble in aqueous solution up to a temperature of 50°C, or carbon are added to the aluminium oxide hydrosol.

50769 X-ray study of $K_6LiFe_{24}S_{26}Cl$, a djerfisherite-like compound. Tani, B.S. (Argonne National Lab., IL). *Am. Mineral.;* **62**: 819-823(1977).

The x-ray powder diffraction pattern of a djerfisherite-like compound, $K_6LiFe_{24}S_{26}Cl$, recovered as one of the reaction products in a battery development program at Argonne National Laboratory, is similar to that of the mineral which occurs in meteorites and in terrestrial vein deposits. A structure of this compound, proposed on the basis of the x-ray data, was refined to an R of 0.06 using 38 FeKα/Mn reflection data. The cell is cubic, probable space group is Pm3m and a = 10.358 +- 0.005 A. The structure has clusters of eight edge-shared FeS_4 tetrahedra about the face-centers of the cube similar to that in pentlandite. Potassium, chlorine, and lithium atoms are distributed among these clusters. 5 tables; 1 figure.

50770 Influence of sodium chloride on the crystallization rate of gypsum. Brandse, W.P. (Univ. of Technology, Delft, Netherlands); van Rosmalen, G.M.; Brouwer, G. *J. Inorg. Nucl. Chem.;* **39**: 2007-2010(1977).

The growth kinetics of gypsum was studied in supersaturated solutions both in pure water and in the presence of NaCl, using a seeded growth technique. Radioactive tracer techniques were employed to follow the growth process. The mean linear growth rate R was plotted against the relative supersaturation sigma. For low sigma values the relation between R and sigma is given by a linear law, for higher sigma values by a parabolic law and for the highest sigma values by a growth "order" higher than two. It was shown that the addition of sodium chloride increased the crystallization rate remarkably. The higher the NaCl concentration the higher the growth rate.

50771 Lithium bis(iminodiacetato)nickelate(II) tetrahydrate and cesium bis(iminodiacetato)nickelate(II) tetrahydrate. Mammano, N.J.; Templeton, D.H.; Zalkin, A. (Lawrence Berkeley Lab., CA). *Acta Crystallogr.;* **B33**: 1251-1254(1977).

$Li_2Ni[NH(CH_2COO)_2]_2.(H_2O)_4$, monoclinic, space group $P2_1/n$ (No. 14), a = 9.785 (5), b = 5.312 (3), c = 15.770 (7) A, β = 99.76 (5)°, Z = 2, d/sub m/ = 1.67, d/sub c/ = 1.672 g cm-3. $Cs_2Ni[NH(CH_2COO)_2]_2.(H_2O)_4$, monoclinic, space group $P2_1/c$ (No. 14), a = 5.024 (3), b = 8.757 (4), c = 21.146 (9) A, β = 96.51 (5)°, Z = 2, d/sub m/ = 2.31, d/sub c/ = 2.366 g cm-3. In each salt the two iminodiacetate (ida) ions which coordinate Ni function as tridentate ligands and are related by a center of inversion at the Ni atom, resulting in a trans configuration for the anion complex, $Ni(ida)_2^{2-}$. The coordination around Ni is in the shape of a distorted octahedron, and the two five-membered rings which result from the coordination of each ida molecule are not planar or equivalent by symmetry; this distortion is related to the bond strain and H atom repulsion within each ida molecule. The two salts are not isostructural.

ISOTOPE EFFECTS

50772 (PUB—112(Vol.2)) History of Met Lab Section C-I, May 1943 to April 1944. Seaborg, G.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1978. Contract W-7405-ENG-48. 581p. Dep. NTIS, PC A25/MF A01.

This is part of a history of the research work of Seaborg and associates in the University of Chicago Metallurgical Laboratory, Chemistry Section C-I. The work was concerned with the development of chemical procedures for the extraction of plutonium, for the purification of plutonium, and for research on the isotopes of other heavy elements including other transuranium elements. The style of the history is that of a diary with footnotes giving additional information. (DLC)

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 49630, 49737, 49741

50773 Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978). 190p. (CONF-770510—P3).

From American Chemical Society meeting; Montreal, Canada (May 1977).

Thirteen chapters provide an overview of the current status of processes for hydrogen isotope separation, with emphasis on heavy water production. Isotopic exchange with methylamine, recovery of heavy water from synthesis gas, catalysts, detritiation of water, and heavy water distillation are among the topics covered. Separate abstracts were prepared for 12 of the chapters; the remaining chapter has been previously abstracted. (DLC)

50774 Novel catalysts for isotopic exchange between hydrogen and liquid water. Butler, J.P.; Rolston, J.H.; Stevens, W.H. (Chalk River Nuclear Labs., Ont.). pp 93-109 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

Catalytic isotopic exchange between hydrogen and liquid water offers many inherent potential advantages for the separation of hydrogen isotopes which is of great importance in the Canadian nuclear program. Active catalysts for isotopic exchange between hydrogen and water vapor have long been available, but these catalysts are essentially inactive in the presence of liquid water. New, water-repellent platinum catalysts have been prepared by: (1) treating supported catalysts with silicone, (2) depositing platinum on inherently hydrophobic polymeric supports, and (3) treating platinized carbon with Teflon and bonding to a carrier. The activity of these catalysts for isotopic exchange between countercurrent streams of liquid water and hydrogen saturated with water vapor has been measured in a packed trickle bed integral reactor. The performance of these hydrophobic catalysts is compared with nonwetproofed catalysts. The mechanism of the overall exchange reaction is briefly discussed. 6 figures.

50775 Combined electrolysis catalytic exchange (CECE) process for hydrogen isotope separation. Hammerli, M.; Stevens, W.H.; Butler, J.P. (Chalk River Nuclear Labs., Ont.). pp 110-125 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

Hydrogen isotopes can be separated efficiently by a process which combines an electrolysis cell with a trickle bed column packed with a hydrophobic platinum catalyst. The column effects isotopic exchange between countercurrent streams of electrolytic hydrogen and liquid water while the electrolysis cell contributes to isotope separation by virtue of the kinetic isotope effect inherent in the hydrogen evolution reaction. The main features of the CECE process for heavy water production are presented as well as a discussion of the inherent positive synergistic effects, and other advantages and disadvantages of the process. Several potential applications of the process in the nuclear power industry are discussed. 3 figures, 2 tables.

50776 Deuterium isotope separation via vibrationally enhanced deuterium halide—olefin addition reactions. Marling, J.B. (Univ. of California, Livermore); Simpson, J.R.; Miller, M.M. pp 134-151 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

The feasibility of a gas phase deuterium separation process is examined which would use IR lasers to augment addition reactions between HX (X = Br, Cl, F, OH) and unsaturated hydrocarbons. High vibrational levels (V > or = 4) of DF or HDO may be excited by a pulsed DF laser. Similar high vibrational excitation of DCl or DBr may be achieved by a pulsed CO laser and spectroscopic details for excitation up to V = 5 are examined. The thermal reaction between HX and unsaturated hydrocarbons is characterized by activation energies between 15 and 57 kcal/mole, depending on olefin structure and choice of HX. The effectiveness of HX/DX vibrational energy in lowering the reaction barrier is discussed. Primary emphasis is given to an overall deuterium separation process utilizing HCl as a closed cycle working gas with aqueous phase redeuteration. Preferred olefin reagents are indicated compatible with CO laser excitation of DCl at a wavelength of 4.9 to 5.3 micron.

50777 Proposed H/D/T separations based on laser-augmented A + B ⇌ C reactions. Bauer, S.H. (Cornell Univ., Ithaca, NY). pp 152-162 of Separation of hydrogen isotopes. Rae, H.K. (ed.). Washington, DC; American Chemical Society (1978).

From American Chemical Society meeting; Montreal, Canada (May 1977).

See CONF-770510—P3.

Thermodynamic and kinetic analyses of adduct production: [A + B (k/sub d/ reversible arrows k/sub a/) C]; K/sub eq/ = k/sub a//k/sub d/, indicate how the steady state composition and rates (forward vs reverse) can be perturbed by absorbable radiation which generates a "spiked" steady state population distribution for one of the species. Three classes of reactions were considered, wherein E/sub a/ ranges from (30 to 40) kcal/mole; (12 to 16) kcal/mole; and (0 to 5) kcal/mole. These are of particular interest for H/D/T separation, in that one of the adducts can be water, a mineral acid (which rapidly equilibrates with water) or hydrogen. Analysis and preliminary experiments indicate that the intermediate case (E/sub a/ approximately 15 kcal/mole) is particularly attractive for LIS.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 49397

50778 Simple cracking and hydrogen rearrangement. Cleavage for oxetanes under electron impact. Substituent effects and energetics. Jones, G. II; McDonnell-Bushnell, L.P. (Boston Univ.). *J. Org. Chem.;* **43**: No. 11, 2184-2189(26 May 1978).

Mass spectral fragmentation of oxetanes substituted with aryl and other groups (9 to 16) gives simple patterns of product ions associated with carbonyl and olefin cycloelimination fragments. For oxetanes substituted with aryl groups in the 2 position, ions resulting from cleavage plus hydrogen rearrangement (ArRC—OH^+) are also prominent. The direction of two-bond cleavage without rearrangement does not correlate well with electron affinities of fragment ions alone. There is general agreement, however, between regioselectivity and overall stability of ions and neutrals, assessed from heats of formation of product pairs. The regiochemistry of fragmentation for 2-aryloxetanes is also correctly predicted by assessment of the relative stabilities of ring-opened valence isomers of the oxetane molecular ions. The competition between cleavage with and without hydrogen migration for 2-aryloxetanes is dependent on ionizing energy, with the former relatively more important at low voltages. A sizable β-secondary deuterium isotope effect on simple cleavage for 16 is also observed (k/sub H//k/sub D/ = 1.08 to 1.02, per deuterium, at 10 to 70 eV). A similarity in regioselectivity for mass spectral and thermal cracking for 2-aryloxetanes is noted.

50779 Doppler-free tow-photon absorption spectroscopy of naphthalene. Chen, K.M.; Khoo, I.C.; Steenhoek, L.E.; Yeung, E.S. (Iowa State Univ., Ames). *Opt. Commun.;* **23**: No. 1, 90-94(Oct 1977).

Doppler-free intracavity two-photon absorption in gas phase naphthalene was demonstrated for the first time. A cw tunable dye laser system was modified to incorporate an intracavity absorption gas cell for this work. A detailed description of the experimental apparatus is given. This technique has many advantages over the conventional pulsed-type setup, and is applicable to other atomic and molecular systems. The observed linewidths of Doppler-free two-photon rovibronic features of naphthalene S_1 reverse arrow S_0 excitation spectrum are on the order of 300 MHz. The combined effects of the laser width, frequency scanning rates and the high density of states prevented us from resolving individual rovibronic lines.

50780 Hydrocracking, cracking, and isomerization of hydrocarbons. Weitkamp, J. (Karlsruhe Univ. (TH) (Germany, F.R.). Engler-Bunte-Institut). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 24-47(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Hydrocracking, cracking, and isomerization of hydrocarbons. Upgrading of low value fractions by chemical conversion is of increasing importance in petroleum refining. In particular, cracking processes have recently become more attractive in Europe. The knowledge of product distributions that may be obtained in the principle cracking processes, i.e., thermal cracking, catalytic cracking, and hydrocracking, is a major basis for ranking these processes. Results of selected experiments with n-alkanes as model hydrocarbons are presented. The course of reaction of hydrocracking over catalysts which are ideally bifunctional is discussed. The flexibility of the hydrocracking process is rationalized in terms of the mechanism. Examples are given for shifts in the mechanism from ideal hydrocracking to catalytic cracking and hydrogenolysis, respectively. It is also shown that ideally bifunctional catalysis is a more generally attractive system that may provide insight into the details of isomerization and cleavage reactions of alkyl-carbenium ions.

50781 Crystal and molecular structure of 2-thiouridine. Hawkinson, S.W. (Oak Ridge National Lab., TN). *Acta Crystallogr., Sect. B;* **33**: 80-85(1977).

The "minor" nucleoside 2-thiouridine, $C_9H_{12}O_5N_2S$, crystallizes in a monoclinic cell, space group $P2_1$ with a = 5.049 (2), b = 7.526 (2), c = 14.050 (3) A, β = 90.17 (2)°, and d = 1.619 g cm^{-3} (for Z = 2) at 22 +- 2°C. The structure was derived from 1334 unique intensities measured with an Oak Ridge computer-controlled diffractometer to a limit of sin theta/lambda = 0.65 A^{-1} with Nb-filtered Mo Kα radiation. Atomic parameters were obtained by a combination of Patterson and Fourier techniques and refined by full-matrix least squares to a final R(F) value of 0.023 for all data. The bond lengths and angles in the molecule agree well with those of other thiopyrimidines [C(2) - S = 1.677 A]. The conformation of the sugar ring relative to the base is anti with a torsion angle chi[O(1')—C(1') → N(1)—C(6)] of 17°. The sugar exists in the 3'-endo conformation. The O(5')—C(5') bond is gauche to C(4) - O(1') and trans to C(4')—C(3') [torsion angles of 74 and -169° respectively]. The molecules are linked together in the crystal by hydrogen bonds in an intricate network which is identical to that inferred by Kojic-Prodic, Liminga, Sljukic and Ruzic-Toros [Acta Cryst. (1974), B30, 1550-1555] for the crystal structure of 5,6-dihydro-2-thiouridine. 2 figures; 6 tables.

50782 Raman study of temperature and pressure effects on vibrational relaxation in liquid $CHCl_3$ and $CDCl_3$. Schoreder, J.; Schiemann, V.H.; Jonas, J. (Univ. of Illinois, Urbana). *Mol. Phys.;* **34**: No. 6, 1501-1521(1977).

The Raman line shapes of the $\nu_1(A_1)$C-H and C-D stretching fundamentals in liquid $CHCl_3$ and $CDCl_3$ were measured as a function of pressure from 1 bar to 4.5 kbar within the temperature range 30 to 90°C. Densities have also been determined under the same experimental conditions. The vibrational relaxation rates are obtained from the isotropic component of the Raman band and the experimental results can be summarized as follows: (i) as T increases at constant density the vibrational relaxation rate increases; (ii) at constant T, the increase in density produces an increase in the relaxation rate; (iii) an increase in temperature at constant pressure results in an increased relaxation rate. The above three cases hold for the $CDCl_3$ liquid, whereas only (ii) may be stated for the $CHCl_3$ liquid. The experimental vibrational data are interpreted in terms of the Kubo stochastic line-shape theory and the collinear-isolated-binary-collision model proposed by Fischer and Laubereau. Application of the Kubo formalism shows that vibrational dephasing is the

dominant relaxation mechanism and that the modulation is fast both in liquid $CHCl_3$ and $CDCl_3$. Interpretation in terms of the binary collision dephasing model leads to the following results: (i) the pure dephasing mechanism seems to be the dominant broadening mechanism for the isotropic Raman line shapes studied; (ii) the calculated dephasing rates as a function of density and temperature show agreement with the experimental data. In these calculations the elastic collision times are obtained from the modified Enskog theory.

50783 Parity of Kekule structures. Randic, M. (Iowa State Univ., Ames). *Mol. Phys.;* **34**: No. 3, 849-856(1977).

The concept of parity of Kekule structures is critically examined. While it appears to be desirable to have a discriminatory device to classify Kekule structures into those with a predominant stabilizing effect and those which destabilize a system relative to an appropriate hypothetical acyclic structure with the same number of CC double bonds, the concept of parity as introduced in the early development of valence theory is found unsatisfactory. A remedy for the situation is proposed which is based on a closer examination of the conjugated circuits present in a system. It is shown that while in many instances the new criterion gives the same classification of Kekule structures as the concept of parity, in other situations where the parity classification leads to ambiguities or unacceptable results the new scheme works well.

50784 2-exo-hydroxy-7-methylbicyclo[2.2.1]heptane-7-syn-carboxylic acid. Chapuis, G.; Zalkin, A.; Templeton, D.H. (Lawrence Berkeley Lab., CA). *Acta Crystallogr.;* **B33**: 1290-1293(1977).

$C_9H_{14}O_3$, monoclinic, $P2_1/c$, a = 11.58 (2), b = 6.874 (10), c = 12.02 (2) A, β = 115.21 (5)°, Z = 4, D/sub x/ = 1.306 (7), D/sub m/ = 1.32 (1) g cm-3, at 22°C. For 798 reflections with I > sigma, R = 0.056 and R/sub w/ = 0.032. The norbornane skeleton shows little distortion by the substituent groups, and the O(hydroxyl)-C(carboxyl) distance (2.87 A) is less crowded than in a salt of a related 2,6,2-methylhydroxy acid which lactonizes more rapidly.

50785 Sodium 2-methyl-6-endo-hydroxybicyclo[2.2.1]heptane-2-endo-carboxylate trihydrate. Chapuis, G.; Zalkin, A.; Templeton, D.H. (Lawrence Berkeley Lab., CA). *Acta Crystallogr.;* **B33**: 560-563(1977).

$C_9H_{13}O_3Na.3H_2O$, monoclinic, $P2_1/c$; a = 15.887 (8), b = 6.459 (4), c = 11.829 (6) A, β = 106.60 (5)°, Z = 4, D/sub x/ = 1.406 (2), D/sub m/ = 1.399 (7) g cm-3, at 23°C. For 1357 reflections with I > 3sigma, R = 0.036 and R/sub w/ = 0.032. Each Na ion is coordinated by five water molecules and an alcohol O atom. Hydrogen bonds between water and the carboxyl groups tie the molecules together in a layer structure. The carboxyl C and hydroxyl O atoms are 2.783 (3) A from each other, and bond angles indicate that the molecule has been deformed to avoid a closer contact.

50786 Synthesis and biological activities of 5-trifluoromethyl-5'-azido-2',5'-dideoxyuridine and 5-trifluoromethyl-5'-amino-2',5'-dideoxyuridine. Lin, T.S.; Chai, C.; Prusoff, W.H. (Yale Univ., New Haven). *J. Med. Chem.;* **19**: No. 7, 915-917(1976).

5-Trifluoromethyl-2'-deoxyuridine (1) was tosylated with p-toluenesulfonyl chloride in dry pyridine at 3° to give 5-trifluoromethyl-5'-O-(p-tolylsulfonyl)-2'-deoxyuridine (2), which was converted to 5-trifluoromethyl-5'-azido-2',5'-dideoxyuridine (3) by reacting with lithium azide in N,N-dimethylformamide at 85-90° for 2 h. Compound 3 was then hydrogenated in ethanol-water (1 : 1, v/v) at room temperature and 35 psi of hydrogen pressure, using 10% palladium on charcoal as catalyst, to yield 5-trifluoromethyl-5'-amino-2',5'-dideoxyuridine (4). Compound 4 is about fourfold less potent than compound 1 as an antiviral agent but is about 40-fold less toxic to the host Vero cells. Thus the therapeutic index of compound 1 has been improved by a factor of 10 by replacement of the 5'-hydroxyl with an amino group. Compound 1, however, is more than 100-fold more inhibitory to Sarcoma 180 cells in culture relative to compound 4. Compound 3 is markedly less potent than compound 1 or 4 as either an antiviral or an antineoplastic compound. 2 figures, 1 table, 16 references.

50787 Synthesis and antiviral activity of 5- and 5'-substituted thymidine analogs. Lin, T.S.; Neenan, J.P.; Cheng, Y.C.; Prusoff, W.H.; Ward, D.C. (Yale Univ., New Haven). *J. Med. Chem.;* **19**: No. 4, 495-498(1976).

The 5'-O-p-tolylsulfonyl derivatives of 5-chloro-, 5-bromo, and 5-iodo-2'-deoxyuridine were synthesized and converted into the corresponding 5-halo-5'-azido-2',5'-dideoxyuridines (5-7). Reduction of 5-chloro-5'-azido-2',5'-dideoxyuridine (5) afforded 5-chloro-5'-amino-2',5'-dideoxyuridine (10, ACIU); however, similar efforts to prepare 5-bromo-5'-amino-2',5'-dideoxyuridine (11) and 5-iodo-5'-amino-2',5'-dideoxyuridine (12) by reduction of the corresponding 5'-azido precursor resulted in the formation of 5'-amino-2',5'-dideoxyuridine (9). 5-Bromo-5'-amino-2',5'-dideoxyuridine (11, ABrU) and 5-iodo-5'-amino-2',5'-dideoxyuridine [12, AIU) were prepared by halogenation of the 5-mercuriacetate of 5'-amino-2',5'-dideoxyuridine. The 5'-amino-2',5'-dideoxy analogs of 5-methyl-, 5-chloro-, 5-bromo-, and 5-iodo-2'-deoxyuridine possess antiviral activity against herpes simplex virus but exhibit no inhibitory activity against sarcoma 180 (murine) or Vero (monkey) cells in culture. 2 tables.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 50778

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 51091

50788 (COO—2793-12) **Nonequilibrium photochemical reactions induced by lasers. Technical progress report.** Steinfeld, J.I. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). Apr 1978. Contract EY-76-S-02-2793. 9p. Dep. NTIS, PC A02/MF A01.

Research has progressed in six principal subject areas of interest to DOE advanced (laser) isotope separation efforts. These are (1) Infrared double resonance spectroscopy of molecules excited by multiple infrared photon absorption, particularly SF_6 and vinyl chloride. (2) Infrared multiphoton excitation of metastable triplet-state molecules, e.g., biacetyl. (3) An Information Theory analysis of multiphoton excitation and collisional deactivation has been carried out. (4) The mechanism of infrared energy deposition and multiphoton-induced reactions in chlorinated ethylene derivatives; and RRKM (statistical) model accounts for all observed behavior of the system, and a deuterium-specific reaction pathway has been identified. (5) Diffusion-enhanced laser isotope separation in $N^{16}O/N^{18}O$. (6) A technical evaluation of laser-induced chemistry and isotope separation.

50789 Concentration effects on the quenching of tris(2,2'-bipyridine)ruthenium(II) emission in polyvinylsulfate solutions. Meisel, D.; Rabani, J.; Meyerstein, D.; Matheson, M.S. (Argonne National Lab., IL). *J. Phys. Chem.;* **82**: No. 9, 985-990(4 May 1978).

The effect of polyvinylsulfate (PVS) on the photoinitiated electron transfer reaction from the lowest charge transfer state of $Ru(bpy)_3^{2+*}$ to Fe(III) and on its dark back reaction was studied under various conditions. A large acceleration of both reactions was observed which can be attributed to concentrating both reacting cations into the field of the polyelectrolyte. However, for the electron transfer from $Ru(bpy)_3^{2+*}$ to Fe(III), the rate constant (normalized for the concentrating "volume effect") was found to increase linearly with the concentration of Fe(III) per polymer molecule up to 25% coverage. Fe(III) complexes with the sulfate groups of PVS, and it seems certain that the increase in the rate constant has its origin in the bonding or chelating of the Fe(III). Possible explanations of the increase are discussed. At high coverage of the polymer by Fe(III) the rate constant starts to drop, most probably due to configurational changes of the polymer induced by the cations. The initial yield of the electron transfer remains unchanged by the addition of PVS while the back reaction was greatly enhanced. In cases where an average of one or less pairs of products were produced per polymer chain a large contribution to the back reaction from a first-order rate law could be observed. As the number of product pairs per polymer molecule increased the dominant portion of this reaction followed a second-order rate law. 2 figures, 2 tables, 31 references.

50790 Exciton interactions in crystalline tetracene studied by single picosecond pulse excitation. Campillo, A.J. (Los Alamos Scientific Lab., NM); Hyer, R.C.; Shapiro, S.L.; Swenberg, C.E. *Chem. Phys. Lett.;* **48**: No. 3, 495-500(15 Jun 1977).

The efficiency of fluorescence in crystalline tetracene was studied as a function of excitation intensity with single picosecond laser pulses. Theoretical fits to the experimental fluorescence-quenching curves, at room temperature and at 170°K, for both a and b-incident polarizations, gave a singlet-singlet annihilation rate of γ/sub ss/ = 10^{-7} cm^3 s^{-1}, to within a factor of two. This rate constant was confirmed by directly measuring the dependence of fast radiative lifetimes on excitation intensity. We also infer a value for the singlet diffusion rate, D/sub s/, of 4 x 10^{-2} cm^2 s^{-1} to within a factor of two. 3 figures, 1 table.

50791 Methods for the calculation of photoionization cross sections using the extended Koopman's Theorem. Chipman, D.M. (Univ. of Notre Dame, IN). *Int. J. Quant. Chem., Symp.;* **11**: 365-377(1977).

A new approach to the calculation of photoionization cross sections for atoms and molecules is described. The procedure requires for input only a wave function for the parent initial state, obviating the necessity of a separate calculation on the final bound state by making use of the recently developed Extended Koopmans' Theorem. Explicit formulas for the photoionization cross sections, in terms of the one- and two-particle reduced density matrices of the initial state wave function, have been obtained at several levels of

sophistication, including the sudden approximation, an orbital model for the photoelectron, and a close-coupling model. In the latter two cases, equations have been derived for the optimization of the continuum orbitals required for the description of the outgoing photoelectron. Approximations which make the optimization equations more tractable are also discussed. 26 references.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 49404

50792 (LBL—6954) **Detection of N-acetylglycine, N-acetylglycylglycine, and N-acetylglycylglycylglycine by paper chromatography.** Sokol, H.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). School of Criminology). Jun 1978. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

This paper reports that the developing solvent of Kirchenmayer and Kuffner, n-butanol-acetic acid-water (8:1:10, v/v) can be used to separate and detect N-acetylglycine, N-acetylglycylglycine, and N-acetylglycylglycylglycylglycine. The chromatographic procedure is described. After heating at 100°C, the spots could be seen under uv light; acetone-bromocresol green-morpholine can also be used to make the spots show up. The R/sub f/ values are 0.59, 0.43, and 0.33, respectively. This procedure was used to detect these compounds in aqueous solutions of diglycine, triglycine, and tetraglycine, which were used as gamma-radiolysis targets. (DLC)

50793 (LBL—7432) **Radiation chemistry of particles accelerated by the Bevalac.** Jayko, M.; Appleby, A.; Christman, E.; Chatterjee, A.; Magee, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

Five systems were studied for carbon, neon, and argon ions: $FeSO_4(10^{-2}$ M)—H_2SO_4(0.4 M)—air; $FeSo_4(10^{-2}$ M)—H_2SO_4(0.4 M)—N_2; HCOONa (5 x 10^{-3} M)—air; NaBr (10^{-3} M)—air; and C_2H_5OH (0.025 M)—$NaNO_3$(0.0025 M)—N_2. In most cases, the G value increases slightly with the beam energy and decreases with Z of the ion. Some primary yields are derived; the radical yield and the water decomposition decrease as the beam penetrates. (DLC)

50794 **Kinetics of chain allyl free radical decay in irradiated bulk film, hydrogenated and extended chain polyethylene.** Dole, M.; Patel, G.N.; Patel, V.M.; Hsu, C.S. (Baylor Univ., Waco, TX). pp 313-323 of Fourth symposium on radiation chemistry. Budapest; Publishing House of the Hungarian Academy of Sciences (1976).

It is shown that it is possible to interpret the kinetic data for the decay of the allyl free radical in polyethylene samples of different morphology in terms of two simultaneous second order reactions of which one or both are diffusion controlled. The decay rates are highest in the sample of highest amorphous volume fraction. The decay constant in the case of the single crystalline PE was the same order of magnitude as k/sub f/ for the HP polyethylene studied here. Apparently there were no slowly decaying chain allyl free radicals in single crystalline polyethylene; this is attributed to the structure of the single crystalline samples in which the allyl free radicals are all probably located in the region of the chain folds between the crystalline lamellae. It should also be noted that in a prevous publication, the allyl decay data for the bulk film and in one case for the extended chain sample was interpreted in terms of a single second order diffusion controlled decay reaction. However, in this paper the data are more extensive and a better interpretation of the data is obtained by means of the two simultaneous reactions theory presented here. For example, in the case of the bulk film, all of the Waite type plots showed a maximum which is characteristic of the kinetics of two simultaneous second order decay reactions.

COMBUSTION CHEMISTRY

REFER ALSO TO CITATION(S) 49362, 49506

50795 **Time-dependent solution of a premixed laminar flame.** Margolis, S.B. (Applied Mathematics Division 8322, Sandia Laboratories, Livermore, California 94550). *J. Comput. Phys.;* **27**: No. 3, 410-427(Jun 1978).

The one-dimensional, time-dependent, multicompenent premixed laminar flame is solved via a highly accurate method of lines approach. The neglect of pressure variations and viscous dissipation and the use of a Lagrangian spatial coordinate reduce the problem to a system of parabolic partial differential equations for the species concentrations and the temperature. Introducing an appropriate B-spline (finite element) basis for the spatial variation and imposing collaction and boundary conditions on the time-dependent coefficients produce a stiff ordinary initial value problem which can be solved by standard techniques. Physical results of special interest include the transient and steady-state profiles of fluid velocity, temperature, and species concentrations through the reaction zone and the upstream velocity (flame speed) of the combustible mixture required to asymptotically stablize the flame. The analysis is illustrated for the case of an oone decomposition flame and a comparison with other theoretical predictions shows that the use of less accurate methods can result in significant errors in the predicted values of minor species profiles and the flame speed.

50796 **Process and equipment for the flame-free combustion of gaseous or vapour fuel/air mixtures.** Koch, C. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,132,819/B/. 23 Jun 1977. 8p. (In German).

The invention concerns a process for the flame-free combustion of gaseous or vapour fuel-air mixtures when passing through a burner with at least one catalyst-free sintering block, where the fuel/air mixture is burned at low throughput at the inlet surface of the catalyst-free sintering block and equipment for carrying out this process. The fuel-air mixture is burned according to the process at the inlet surface of a sintering block provided with flow openings, until this has reached a temperature of approximately 950°C. There is then an increase of flow of the mixture to ten to fifty times the original flow. This presses the combustion reaction into the sintering block, whose temperature is increased in this way to between 1000 and 2000°C.

ENGINEERING

REFER ALSO TO CITATION(S) 50428

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 50958

50797 (BDX—613-1917) **Joint IMOG/NMTBA meeting: Overview of direct numerical control.** Finlay, G.L. (Bendix Corp., Kansas City, Mo. (USA)). 5 Oct 1977. Contract EY-76-C-04-0613. 18p. (CONF-7710141—1). Dep. NTIS, PC A02/MF A01.

From IMOG/NMTBA meeting; Atlanta, GA, USA (11 Oct 1977).

Since DNC was first introduced, four contractors for ERDA have become actively involved with its utilization. These contractors are Rockwell International, which operates the Rocky Flats plant at Golden, Colorado; Union Carbide Corporation operating the Y-12 plant at Oak Ridge, Tennessee; Sandia Laboratories, operating a plant in Albuquerque, New Mexico and the Bendix Corporation with a plant in Kansas City, Missouri. DNC activities at the four sites are elucidated by slides. At the present time, these four plants have a total of 17 machine tools operating under DNC control with over 50,000 of DNC operating time. Present planning calls for the addition of about this many more machines by the end of FY 1978.

50798 (BDX—613-2018) **Direct numerical control at Bendix Kansas City Division.** Finlay, G.L. (Bendix Corp., Kansas City, Mo. (USA)). 28 Mar 1978. Contract EY-76-C-04-0613. 68p. (CONF-780456—2). Dep. NTIS, PC A04/MF A01.

From EVER-37 CAD-CAM meeting; Sandia, Albuquerque, NM, USA (10 Apr 1978).

Background information concerning how and why Bendix Kansas City became interested in numerical control of machine tools and what the approach was in determining whether it would prove beneficial is presented. The present status of implementation and future plans are discussed. The material is presented by 22 slides. (TFD)

50799 (BDX—613-2051) **Moore No. 5 diamond turning machine design and description.** Setter, D.L. (Bendix Corp., Kansas City, Mo. (USA)). 1978. Contract EY-76-C-04-0613. 10p. (CONF-780645—2). Dep. NTIS, PC A02/MF A01.

From SME precision machining and gaging conference; Williamsburg, VA, USA (27 Jun 1978).

A unique Moore No. 5 diamond turning machine has been acquired from the Moore Special Tool Co. as part of a program to upgrade the turning capability at Bendix Kansas City. The design considerations used and a complete description are included.

50800 (SAND—78-8013) **Adaptive telemeter.** Kellom, A.W. (Sandia Labs., Livermore, Calif. (USA)). Jun 1978. Contract EY-76-C-04-0789. 54p. Dep. NTIS, PC A04/MF A01.

Thesis. Submitted to Univ. of California, Davis.

Telemetry data is the single most important source of information for missile system evaluation. Current telemetry systems encode data on launch environment, launch and stage ignition, reentry vibration, steering commands, final guidance, background data, and impact using fixed-format encoders. These fixed-format encoders assign to each signal a portion of the data bandwidth, which remains committed throughout the missile flight regardless of the presence or absence of information. Because bandwidth is limited, data requirements are sometimes compromised to fit the encoder capacity. Also, telemetry redesign in case of changing requirements is expensive and time-consuming. Methods by which these problems can largely be solved are considered. Through the use of on-board microprocessors, data can be sent immediately or stored for later transmission thus better using available bandwidth. Transmission frequencies can be varied according to need and the phase of the missile trajectory. Redesigns, when required, can be accomplished inexpensively by modifying software instead of hardware. Microprocessor systems also can include facilities for self-checking, data compression, and dealing with data priority and data identification. A representative system is considered that is designed around the Microproc 16.

50801 (SLAC-TN—78-1) **Emergency power source for an ion vacuum pump.** Taylor, E.A. (Stanford Linear Accelerator Center, Calif. (USA)). May 1978. Contract EY-76-C-03-0515. 2p. Dep. NTIS, PC A02/MF A01.

A simple high voltage dc generator which serves as an emergency power source for an ion vacuum pump during power interruptions, or failure of the main supply is described.

50802 Limited axial powers of water heat pipes in vertical operation with gravity. Mojtabi, A. (Laboratoire d'Aerothermique du C.N.R.S., Meudon, France). *Lett. Heat Mass Transfer;* **5**: No. 2, 141-148(1978). (In French).

The axial limitations of various types of copper heat pipes operating at vertical inclination were determined experimentally. For a vertical position, it appears, from this experimental study that the wick structure used over the evaporator does not affect the axial power limit. This power varies very little between this position and the 45° inclination to it. Moreover, after a drying out of the evaporator, the heat pipe, which is in vertical position and gravity assisted, re-starts in operation.

50803 Earthquake tests on high-performance open jet switches. Augustin, H.G. *Tech. Mitt. AEG-Telefunken;* **67**: No. 5/6, 273-275(Dec 1977). (In German).

The experimental techniques for determining earthquake resistance are described on the basis of physical principles and illustrated by the tests on a 245-kV switch. The safety of the switch against earthquakes was proven up to an acceleration of 0.5 g.

50804 Effect of geometrical parameters of plate surface on technical and economic indices of heat exchangers. Shishkov, V.M.; Sochenov, V.N.; Anisin, A.K.; Pomozov, Yu.E.; Sinyavin, V.I. (Bryansk Inst of Transp Mach, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 83-89(Oct 1977). (In Russian).

Based on calculations and experimental investigations, measures are proposed to make plate heat exchangers more compact and thermally efficient. Criterial equations of heat transfer and resistance are presented for a new type of plate surface. It is shown that the use of flat intermediate sheets in designing plate surface improves efficiency of a heat exchanger and reduces the costs of its manufacture while at the same time reducing its size.

50805 Heat transfer in steam condensation on a vertical cylindrical surface below the point of transition from the liquid to the solid state. Tselishchev, P.A.; Bogacheva, T.M.; Abayev, G.G. (Krzhizhanovskiy Energ Inst, USSR). *Heat Transfer - Sov. Res.;* **9**: No. 2, 66-72(Mar-Apr 1977).

Steady-state heat transfer from steam condensing at a temperature above the triple point of water on a vertical cylindrical surface whose temperature is lower than the freezing temperature is investigated. Experimental data for steam condensing in a vertical tube at cooling-liquid temperatures as low as -30°C are presented.

50806 Approximate method for calculating the heat-transfer agent flowrate through a plane-parallel, porous heat-pipe wick. Shcherbakov, V.K.; Semena, M.G.; Sharayevskii, I.G. (Kiev Polytech Inst, Ukr SSR). *Heat Transfer - Sov. Res.;* **9**: No. 2, 114-119(Mar-Apr 1977).

An approximate method for determining the flowrate of the heat transfer agent through a plane-parallel porous heat-pipe wick is analyzed. The rate of heat transfer agent absorption on the wick surface is determined by methods of pressure under pressure. 5 refs.

50807 Investigation of hydrodynamic characteristics of heat pipes. Melodiev, E.A.; Manokhin, V.Ya.; Turbin, V.S. *Izv. Vyssh. Uchebn. Zaved., Mashinostr.;* No. 10, 78-81(1977). (In Russian).

Results of an investigation of hydrodynamic characteristics of heat pipes with an inner downcoming loop and a separating insert at the condenser inlet are presented. Studies of the circulation in the pipe loop are conducted on glass models. It is found that a stable circulation in the loop is observed under annular conditions of flow of a two-phase stream of the heat carrier. By using the separation insert, the heat and mass transfer is intensified thanks to an increase in the rate of the flow and the multiplicity factor of the circulation.

50808 Projectile nose design for energy absorption at oblique impact. Nelson, D.B.; Miller, J.C. (Sandia Labs., Livermore, CA). pp 26-33 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

The survival of a parachute retarded projectile following impact depends to a large degree on the amount of kinetic energy removed during the initial surface contact period. The objective of nose design is to remove as much energy as possible for oblique impact and to limit inertial forces to tolerable levels while satisfying geometric deformation constraints for near normal impact. This may be accomplished by choosing the nose material so that plastic deformation occurs throughout contact and by designing the nose shape so significant target deformation/destruction is assured. A rather simple analysis demonstrates the beneficial effects of friction and indicates that nose material strength has a minimal effect on post impact dynamics for oblique impact conditions.

50809 (DOE-tr—94) **Heat pipes and thermally anisotropic structures.** Martinet, J. [nd]. Translation: source information not available. 16p. Dep. NTIS, PC A02/MF A01.

Handwritten note: ATP "Solar Habitat 1".

The design and operation of a thermally anisotropic structure, i.e., a composite "wall" characterized by a different value of thermal conductivity according to the direction of transfer, are described. This structure consists of two separated metal plates, each one of which is supplied on its inside surface with a metal cone into which are fitted the ends of a cylindrically shaped heat pipe. The heat pipe spans the cone-to-cone distance between the plates, and transfers heat from plate 1 to plate 2. The heat transfer capabilities of the wall are calculated, and the steps required for fabricating the heat pipe are described. (LCL)

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 50353, 50533, 50938, 51638

50810 (ANL—78-35) **Symposium on applications of superconducting quantum interference devices (SQUIDS).** (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 67p. (CONF-780339—(Abstr.)). Dep. NTIS, PC A04/MF A01.

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The abstracts are given of thirteen papers presented at a "SQUID Symposium" organized by the Division of Materials Sciences of the U.S. Department of Energy and held March 23—25, 1978, at the University of Virginia. Since SQUID systems have already been utilized in feasibility demonstration in geothermal reservoir exploration, it was recognized that these devices also hold great potential for many other important scientific measurements. Many of these are energy-related, and others include forefront investigations in a diverse group of scientific areas, from biomedical to earthquake monitoring. Research in SQUIDs has advanced so rapidly in recent years that it was felt that a symposium to review the current status and future prospects of the devices would be timely. The abstracts given present an overview of work in this area and hopefully provide an opportunity to increase awareness among basic and applied scientists of the inherent implications of the extreme measurement sensitivity in advanced SQUID systems.

50811 (CONF-7709120—1) **Development of a 6250 KVA superconducting generator.** Fujino, H.; Iwamoto, M. (Fuji Electric Co. Ltd., Yokosuka, Kanagawa (Japan). Central Research Lab.; Mitsubishi Electric Corp., Amagasaki, Hyogo (Japan). Central Research Lab.). 1977. 32p. Dep. NTIS (US Sales Only), PC A03/MF A01.

From 11. meeting of CIGRE S. C.; Geneva, Switzerland (5 Sep 1977).

In Japan, a 6250 KVA superconducting generator was constructed. The design and construction of this machine and the experience obtained in this program for studying the feasibility of superconducting generators are discussed.

50812 Characteristics of germanium resistance thermometers from 1 to 35 K and the ISU magnetic temperature scale. Anderson, M.S.; Swenson, C.A. (Ames Laboratory-USDOE and Department

of Physics, Iowa State University, Ames, Iowa 50011). *Rev. Sci. Instrum.;* **49**: No. 8, 1027-1033(Aug 1978).

A low-temperature comparator cryostat with a self-balancing ac resistance bridge and a data acquisition system have been used over the past several years to calibrate approximately 45 germanium resistance thermometers, many of them several times. Examples are given of typical thermometer reproducibility results, together with algorithms for estimating self-heating and ac—dc resistance differences for these thermometers. Recent experiences with rhodium—iron resistance thermometry are described in terms of a comparison of previous ISU magnetic thermometry with gas thermometry results from the National Physical Laboratory in England.

50813 Turbogenerators with superconducting windings and excitation. Morini, A. (Univ di Padova, Italy). *Elettrotecnica;* **64**: No. 12, 1001-1019(Dec 1977). (In Italian).

The feasibility of large superconducting alternators is evaluated and their potential advantages and limitations are identified. The main characteristics of design and construction of such machines at the present state-of-the-art are emphasized. The general conclusions resulting from the experimental prototypes are that superconducting turbogenerators should be realizable advantageously and there are no fundamental problems that exclude the extension of the present experience to larger generators, even if a large amount of work remains to be done in design optimization, experimental verification and economic evaluation.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 49655

50814 (ORNL/CSD/TM—55) **Nuclear criticality safety of the fuel element fabrication facility at Attleboro, Massachusetts.** Thomas, J.T. (Oak Ridge National Lab., Tenn. (USA)). Jun 1978. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

The Attleboro Facility produces fuel elements for the ORR and the HFIR reactors at the Oak Ridge National Laboratory and for the HFBR reactor at the Brookhaven National Laboratory. It is proposed to utilize the criticality indicator system (CI) as a method for nuclear criticality control at the Attleboro fuel element fabrication facility. Application of the method requires an evaluation be made of the effect of hydrogenous moderation on the potential neutron multiplication factor of operations. Analyses are given which confirm the applicability of the CI system under credible normal and possible abnormal contingencies. It is also shown that no significant neutron multiplication occurs during normal operations and that a k/sub eff/ not exceeding 0.5 may be expected for abnormal conditions.

50815 (ORNL/CSD/TM—58) **Nuclear criticality assessment of Oak Ridge research fuel element storage.** Thomas, J.T. (Oak Ridge National Lab., Tenn. (USA)). Jun 1978. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

Spent and partially spent Oak Ridge Research Reactor (ORR) fuel elements are retained in the storage section of the ORR pool facility. Determination of a maximum expected neutron multiplication factor for the storage area is accomplished by a validated calculational method. The KENO Monte Carlo code and the Hansen-Roach 16-group neutron cross section sets were validated by calculations of critical experiments performed with early ORR fuel elements and with SPERT-D fuel elements. Calculations of various fuel element arrangements are presented which confirm the subcriticality previously inferred from critical experiments and indicate the k/sub eff/ would not exceed 0.85, were the storage area to be filled to capacity with storage racks containing elements with the fissionable material loading increased to 350 g of ^{235}U.

50816 (RFP—2742) **Quality plan for criticality safety calculations at Rocky Flats.** Pecora, D. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 1978. Contract EY-76-C-04-3533. 23p. (CONF-780622—24). Dep. NTIS, MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Portions of document are illegible.

The text of the plan is given, and some of the guidelines followed in writing it are discussed to aid others who may be faced with the same task. The plan is divided into four sections. The Introduction describes the general functions and purpose of the calculational program. The second section, Activities and Responsibilities, lists specific tasks and their purposes and assigns responsibility for performance. The third section references relevant documentation (e.g., ANSI standards), and the final section describes quality plans for specific functions.

50817 (Y/DD—254) **Adventures in ten dimensions: misleading assumptions in array analysis.** Hopper, C.M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1978. Contract W-7405-ENG-26. 8p. (CONF-780622—14). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

It is concluded that nearly all assumptions related to a moderated-array calculational study must be tested. For instance, a calculation of full-density, highly enriched uranium loadings is not in itself proof of the safety for all lower densities, lower enrichments, or material diluents that may occur. The only assumptions which may not need testing are that (1) the reduction in mass of fissile material loadings, or (2) a reduction in the number of packages within an array will produce lower k/sub eff/ values.

50818 Quality assurance plan for criticality safety calculations at Rocky Flats. Pecora, D. (Rockwell International, Golden, CO). *Trans. Am. Nucl. Soc.;* **28**: 285(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50819 Observations on problem solving in nuclear criticality safety. Stevenson, R.L. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.;* **28**: 285-286(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50820 (ORNL-tr—4461) **Design of gas-filled double-bend ducts in concrete shields against gamma radiation: definitions and conditions. DIN 25 427, Part 1.** (DIN Deutsches Inst. fuer Normung e.V., Berlin (Germany, F.R.)). [nd]. Translated by J. Lee from the German, Deutsche Normen, October 1977, 3p. 8p. Dep. NTIS, PC A02/MF A01.

This standard is intended to enable builders of nuclear facilities, particularly of hot cells and other similarly shielded plant components, to determine without the aid of shielding calculations whether a gas-filled, double-bend duct passing through a thick shield will satisfy shielding requirements and how changes in the design parameters, especially in duct cross section, in the length of the legs, and in the necessary insertions in the concrete shield, will affect these requirements. Therefore, the standard contains simple rules and diagrams for obtaining a sufficiently reliable design of such ducts exhausting the existing possibilities in each case. In border-line cases where measurement latitude is severely limited, it is recommended that a more precise calculation of the expected shielding effect be done as a check on the actual possibilities. 2 figures.

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 50262

50821 (SAND—77-0001) **Severities of transportation accidents involving large packages.** Dennis, A.W.; Foley, J.T. Jr.; Hartman, W.F.; Larson, D.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1978. Contract EY-76-C-04-0789. 167p. Dep. NTIS, PC A08/MF A01.

The study was undertaken to define in a quantitative nonjudgmental technical manner the abnormal environments to which a large package (total weight over 2 tons) would be subjected as the result of a transportation accident. Because of this package weight, air shipment was not considered as a normal transportation mode and was not included in the study. The abnormal transportation environments for shipment by motor carrier and train were determined and quantified. In all cases the package was assumed to be transported on an open flat-bed truck or an open flat-bed railcar. In an earlier study, SLA-74-0001, the small-package environments were investigated. A third transportation study, related to the abnormal environment involving waterways transportation, is now under way at Sandia Laboratories and should complete the description of abnormal transportation environments. Five abnormal environments were defined and investigated, i.e., fire, impact, crush, immersion, and puncture. The primary interest of the study was directed toward the type of large package used to transport radioactive materials; however, the findings are not limited to this type of package but can be applied to a much larger class of material shipping containers.

50822 (Y/LA—789) **Oak Ridge, Y-12 Plant DT-14 fissile material shipping container (a safe and economical method of packaging enriched uranium).** Crowder, H.E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1978. Contract W-7405-ENG-26. 5p. (CONF-780506—12). Dep. NTIS, PC A02/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The DT-14 is a unique shipping container—it provides a safe containment for shipments of enriched uranium in solid form, in solutions, and as oxides. This container will enable Union Carbide's Y-12 and K-25 Plants in Oak Ridge to eliminate the use of several types of fissile material shipping containers such as: the DOT-SP-

5560 solution container, the DOT-SP-5765 shipping container, and the DOT-SP-5463 (Foamglas) container.

50823 Waste transportation systems. Sutherland, S.H.; Freedman, J.M.; Allen, G.C. Jr.; Renken, J.H.; Dupree, S.A. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **28**: 347-348(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50824 High-speed impact and fire test of a spent-fuel rail cask system. Yoshimura, H.R.; Huerta, M.; Nilson, R.H.; Pop, R.B. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **28**: 348-349(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

MINING AND DRILLING EQUIPMENT AND FACILITIES

50825 Rock bits enter a new era. Booth, D. *Offshore Serv.;* **11**: No. 3, 23-24, 27-28(Mar 1978).

The design, operation, materials selection, bearing selection, cost, and performance of drill bits for offshore drilling are discussed in detail. The economic advantages of tungsten carbide insert bits with journal bearings are shown. (LCL)

50826 Roller bit for rock drilling. Bechem, K.G. (to Soeding (J.C.) und Halbach, Hagen (Germany, F.R.)). German(FRG) Patent 1,805,335/B/. 24 Mar 1977. 3p. (In German).

In order to produce the optimum drilling progress and to reduce wear, the following design is recommended for the use of roller tits, where the cutting elements consist of wedge-shaped cutters, which run on the same tracks and are fitted in a staggared fashion: the above cutting elements are made as hard metal pins, which can be supported by ribbed wedges. The staggered cutting elements consist of continuous cutters and lie between the rows of hard metal pins. The second cutting elements have the purpose of wearing away the ribs left behind by the hard metal pins, and thus creating a new surface for the formation of indentations by the hard metal pins.

LASERS

REFER ALSO TO CITATION(S) 51632

50827 (COO—4275-3) **Metal vapor excimer laser. Quarterly progress report, November 1, 1977—January 31, 1978.** Kovacs, M.A.; Jacob, J.H. (Avco-Everett Research Lab., Everett, Mass. (USA)). Mar 1978. Contract ES-77-C-02-4275. 33p. Dep. NTIS, PC A03/MF A01.

During the reporting period the final construction stages of the Cd: Hg experiment was reached. The major accomplishments were in the experimental areas where the vapor supply oven was completed, the guide magnet assembly tested, and tests on the electron beam energy deposition with the Febetron 736 were started. In terms of discharge/kinetic modeling, the matter of recombination "smoothing" discussed in the last Quarterly was further investigated. The degree of axial electron density "smoothing" arising from recombination was found to depend on both the electron-ion recombination and molecular ion formation rates: the slower the molecular ion formation rate relative to the electron-ion recombination rate, the lesser the degree of smoothing. Recombination "smoothing"can still be significant in the CD: Hg experiment, although a precise estimate is difficult to achieve since the effect depends strongly on the rates (and their temperature dependence) which are not well known.

50828 (SAND—77-2100C) **Measurements of flow-field properties in a gasdynamic laser nozzle wake.** Peterson, C.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 9p. (CONF-780711—4). Dep. NTIS, PC A02/MF A01.

From 11. AIAA fluid and plasma dynamics conference; Seattle, WA, USA (10 Jul 1978).

Detailed measurements were made in the nonreacting (cold flow) wake of a gasdynamic laser (GDL) nozzle array to provide flow-field data with which to evaluate theoretical GDL fluid mechanical models and numerical prediction schemes. Pilot pressure, stagnation temperature, and static pressure measurements were made across the wake and along the wake centerline at twelve streamwise locations and at two nozzle Reynolds numbers. Redundant static pressure measurements were made to identify and correct any probe interference errors caused by the small dimensional wake scales. Pitot measurements across the GDL nozzle boundary layer were included to provide information on the initial conditions to the wake, and hot wires were used to define the wake turbulence level. Turbulent wake centerline data agreed closely with turbulent predictions from an existing linearized wake theory. Measurements in a transitional wake indicated that transition begins near the wake edge and moves toward the wake centerline as Reynolds number is increased. Centerline flow properties observed in the transitional wake could not be predicted by either laminar or turbulent linearized theory.

50829 (UCRL—81081) **Optical fabrication of fluorophosphate laser glasses.** Brown, N.J.; Maney, R.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 May 1978. Contract W-7405-ENG-48. 12p. (CONF-780545—3). Dep. NTIS, PC A02/MF A01.

From Meeting of the American Ceramic Society; Detroit, MI, USA (6 May 1978).

Current research on the fabrication of fluorophosphate glass, a possible candidate for the Shiva Nova laser fusion project is discussed. Small samples have been polished to what appear to be adequate quality.

50830 Large-signal gain and intensity enhancement in a backward Raman amplifier. Murray, J.R.; Goldhar, J.; Eimerl, D.; Szoeke, A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Appl. Phys. Lett.;* **33**: No. 5, 399-401(1 Sep 1978).

Saturation effects have been investigated in a KrF laser-pumped backward Raman amplifier using methane gas. Pump depletion of 30% with an intensity gain of 2 has been demonstrated, and the results are shown to be consistent with a simple Frantz-Nodvik saturation treatment.

50831 Measurement of excited-state-absorption loss for Ce^{3+} in $Y_3Al_5O_{12}$ and implications for tunable 5d→4f rare-earth lasers. Jacobs, R.R.; Krupke, W.F.; Weber, M.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Appl. Phys. Lett.;* **33**: No. 5, 410-412(1 Sep 1978).

Broad bandwidth 5d→4f transitions in Ce^{3+} have been considered for tunable laser action. In this letter, optical probe measurements of excited Ce^{3+} ions in $Y_3Al_5O_{12}$ show that stimulated emission in the 550—610-nm region is not possible at 295 K because of excited-state absorption. Transient measurements demonstrate that part of this loss has ≅75-ns lifetime and is associated with absorption from the lowest 5d level; a longer-lifetime loss is also observed. The excited-state-absorption loss is reduced at lower temperatures.

50832 Intense lasing in discharge excited noble-gas monochlorides. Sze, R.C.; Scott, P.B. (University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Appl. Phys. Lett.;* **33**: No. 5, 419-421(1 Sep 1978).

Intense lasing of XeCl (180 mJ) and KrCl (100 mJ) occurs using HCl as the halogen doner. The low energies obtained from e-beam devices are believed to result from Ar^+_2 molecular-ion absorption. Very long XeCl lasing lifetime with respect to gas fill is observed; this is postulated to be the result of photodissociation of Cl_2 due to the laser wavelength which, in turn, results in enhanced rates for the formation of HCl.

50833 Suppression of self-focusing through low-pass spatial filtering and relay imaging. Hunt, J.T.; Glaze, J.A.; Simmons, W.W.; Renard, P.A. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Appl. Opt.;* **17**: No. 13, 2053-2057(1 Jul 1978).

Self-focusing effects in large, high power laser amplifiers become manifest as small-scale beam instabilities and as large-scale phase aberrations. Spatial filtering has been shown to control instabilities; spatial filters constitute appropriate lens pair elements for image relaying as well. In this paper, image relaying is presented as a technique for preserving the transverse intensity profile of a high power beam as it propagates long distances through nonlinear elements. As a consequence, amplifier apertures can be filled more effectively, leading to a doubling of fixed-aperture system performance. A rationale for optimal selection of spatial filter bandpass is also presented. This selection, as might be expected, depends upon details of the beam's spatial structure as it enters any filter. A geometrical optics approach is used throughout; nevertheless, derived results remain valid when diffraction is included.

50834 Saturable absorbers for CO_2 fusion. Ladish, J.S.; Czuchlewski, S.J. (Los Alamos Scientific Lab., NM). *Laser Focus;* **14**: No. 6, 55-56(Jun 1978).

Parasitic oscillations, which had prevented full-power operation of the final amplifiers in the eight-beam carbon-dioxide laser developed for fusion experiments at the Los Alamos Scientific Laboratory, were suppressed with a gaseous saturable-absorber cell. With the cell installed in an amplifier, a single beam of the eight-beam system produced pulses at its design level of 1.3 kilojoules in

one nanosecond. Installation of similar cells in the other seven arms of the laser is under way, with full-power operation of the entire system expected to begin this spring. The input signal to the final amplifiers makes three passes through the gain medium to reduce the input power required and to make efficient use of the stored energy.

50835 Coherence and beam geometry of a superradiant dye laser. Grieneisen, H.P.; Francke, R.E.; Lago, A. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Instituto de Fisica). *Appl. Phys.;* **15**: No. 3, 281-286(Mar 1978).

This paper reports the observation of a well defined radiation mode emitted from a superradiant dye laser pumped by a pulsed nitrogen laser. Beam geometry and spatial coherence of the dye laser are studied in connection with the pumping geometry. It is shown that under favorable pumping conditions most of the excited molecules radiate into the same spatial mode by stimulated emission. The associated mode structure is also calculated based on a model of a properly phased dipole distribution. The calculated emission pattern reproduces the observed far field pattern closely.

50836 Instability of laser cw oscillation in the presence of a passive medium. Knapp, H.; Risken, H.; Vollmer, H.D. (Ulm Univ. (Germany, F.R.). Abt. Theoretische Physik 1). *Appl. Phys.;* **15**: No. 3, 265-270(Mar 1978).

For a homogeneously broadened two-level ring laser model the stability of the c-w laser oscillation in the presence of a passive medium is investigated. The passive material is treated similar to the active material, but without an external pumping mechanism. Stable and unstable regions are shown for various parameters. The stability region of the c-w solution becomes extremly small for certain parameters.

50837 High-repetition-rate pulsed CO_2 laser. Baranov, V.Y.; Klepach, G.M.; Malyuta, D.D.; Mezhevov, V.S.; Niz'ev, V.G.; Chalkin, S.F. (I. V. Kurchatov Institute of Atomic Energy). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 824-828(Mar 1978).

The effect of weak shock waves produced during rapid delivery of energy to a pulsed, flow-through CO_2 laser on its pulse repetition rate is theoretically examined. The effect of the accumulation of the energy dissipated by the shocks as they propagate along the flow is examined in the weak shock approximation. It is shown that the effect of these shocks may be neglected in the one-dimensional problem even if this energy accumulation is included. Some calculations are presented which demonstrate that in real devices the upstream heating of gas may be significant. Preliminary experimental results from a study of a CO_2 laser with a pulse repetition rate of up to 100 Hz are presented. An average power of 800 W has been obtained.

50838 Investigations on unsaturated optical gain spectra of GaAs-GaAlAs-DHS lasers at above-threshold conditions. Hildebrand, O.; Goebel, E.; Loehnert, K. (Stuttgart Univ. (TH) (Germany, F.R.). Physikalisches Inst.). *Appl. Phys.;* **15**: No. 2, 149-152(Jan 1978).

Directly measured unsaturated gain spectra of GaAs-GaAlAs double hetero-structure wafers at above-threshold conditions are reported for different temperatures. Maximum gain values are in the order of 100 $cm^{-}1$ for room temperature and up to 1000 $cm^{-}1$ for liquid helium bath temperature. Best fit of the gain spectra is obtained using lines shapes corresponding to band-to-band transitions without validity of k-selection rule and including tail states. The temperature dependence of the maximum gain agrees with these assumptions.

50839 Astigmatically compensated cw dye laser resonators using lenses. Hueffer, W.; Schieder, R.; Brinkmann, U. (Koeln Univ. (Germany, F.R.). 1. Physikalisches Inst.). *Appl. Phys.;* **15**: No. 2, 157-161(Jan 1978).

The compensation of the astigmatism of Brewster-angled dye cells can be performed with lenses as well as with spherical mirrors. The advantages of cw dye laser resonators using lenses lie in the linear configuration of the optics and the convenient adjustability of astigmatism compensation. An output efficiency of 30% already at 1.6 W pumping power has been observed. In addition, ring laser resonators with lenses have been investigated and they delivered up to 400mW single mode power in travelling wave operation at less than 2 W pumping power.

50840 High-power argon-ion laser with titanium covered beryllia discharge tube. Muuss, H.; Schoenmakers, H. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Angewandte Physik 1). *Appl. Phys.;* **15**: No. 2, 229-232(Jan 1978).

A new type of discharge tube for high-power argon-ion lasers constructed of a segmented metal-ceramic compound system is described. Up to date, the system has been operating for 1500 h without failure. The maximum cw output is 140 W, limited by the destruction of the mirrors.

50841 High-energy dye laser pumped by wall-ablation lamps. Okada, T.; Fujiwara, K.; Maeda, M.; Miyazoe, Y. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering). *Appl. Phys.;* **15**: No. 2, 191-196(Jan 1978).

A guideline for the optimum design of linear wall-ablation lamps is presented with a simple empirical formula which describes the luminescent characteristics of lamps. The absolute luminescent efficiency of the wall-ablation lamp was measured. A high-energy dye laser with a quadruple-elliptical cylindrical cavity was constructed using these lamps, and an output energy of 23.3J (11.6 MW) was obtained with an overall efficiency of 0.31%. The energy-flow diagram of this laser system was computed with a rate-equation analysis, and the conversion efficiency from electrical imput to laser output was determined. One can expect an overall efficiency of about 2%.

50842 Generation of coherent radiation at 89.6 nm through two-photon resonant phase-matched tripling of fourth-harmonic Nd: glass laser radiation in Hg vapors. Slabko, V.V.; Popov, A.K.; Lukinykh, V.F. (AN SSSR, Krasnoyarsk. Inst. Fiziki). *Appl. Phys.;* **15**: No. 2, 239-241(Jan 1978).

Coherent radiation at 89.6 nm has been obtained through third-harmonic conversion of the 268.8 nm pulses in mercury vapors. Tunability of the fourth-harmonic frequency of the Nd: glass laser radiation to the $6s^1S_0$-$8s^1S_0$ double quantum resonance of Hg atoms has been used for the resonant enhancement of the twelfth-harmonic output. Possibility to phase match the generated radiation and driving polarisation in pure vapors without employing of buffer gas has been demonstrated.

50843 Optically-pumped mercury vapor laser. Holmes, N.C. Stanford, CA; Stanford Univ. (1978). 79p. University Microfilms Order No. 78-08,798.

Thesis (Ph. D.).

Both the theoretical and practical aspects of the optically pumped cw mercury vapor laser at 546.1 nm were explored. A rate-equation analysis was used to develop a quantitative model describing the nitrogen pressure dependence of laser power output and unsaturated gain. Careful measurements show the model to be in excellent agreement with experiment. Measurements were also made as the pumping rates, bore diameter, and mercury density were varied. A qualitative treatment of the effects of high intensity pumping and radiation trapping is given, and this analysis is consistent with the observed bahavior. The nitrogen quenching rate across the laser transition was found to be 7×10^5 sec^{-1}-$torr^{-1}$, and the pressure broadening of the green laser line was inferred to be 26.4 MHz/torr. A detailed description of the experimental apparatus is given. Together with the experimental measurements, this work can provide a basis for the design of practical mercury laser systems.

50844 Electron-beam-excited XeCl laser. Bychkov, Y.I.; Losev, V.F.; Mesyats, G.A.; Tarasenko, V.F. *Sov. Tech. Phys. Lett. (Engl. Transl.);* **3**: No. 12, 509-510(Dec 1977).

The efficiency of a $XeCl^*$ laser is studied for 300 keV electron-beam excitation. The output is measured as functions of pressure and Ar additions.

50845 Generation of the third and fifth harmonics in a tunable neodymium-glass laser in cesium vapor. Slabko, V.V.; Popov, A.K.; Lukinykh, V.F. (L. V. Kirenskii Institute of Physics, Siberian Branch, Academy of Sciences of the USSR, Krasnoyarsk). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **3**: No. 12, 522-523(Dec 1977).

The energy of the third and fifth harmonics of a neodymium-glass laser is measured as a function of temperature under conditions close to the two-photon resonance.

50846 Harmonic emission higher harmonics in an electrically pumped CO laser. Konev, Y.B.; Kochetov, I.V.; Kurnosov, A.K.; Pevgov, V.G. *Sov. Tech. Phys. Lett. (Engl. Transl.);* **3**: No. 12, 523-524(Dec 1977).

The gain of a CO laser subjected to electric discharge pumping is calculated at the fundamental frequency and two harmonics as a function of temperature.

50847 Experimental high-pressure, gas-laser system. Basov, N.G.; Brunin, A.N.; Danilychev, V.A.; Milanich, A.I.; Khodkevich, D.D.; Kerimov, O.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **3**: No. 12, 534-535(Dec 1977).

A electron beam accelerator system using a seven-stage Marx pulse voltage generator is described and used to pump a KrF laser.

50848 Stabilization by an external signal of a solid-state ring laser with additional mirrors. Murina, T.A.; Rozanov, N.N. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **43**: No. 5, 561-565(Nov 1977).

Two types of relaxation oscillation for radiation with frequencies differing by a factor of about $\sqrt{2}$ times are found for the single-frequency regime of a solid-state ring laser without backscattering. It is shown that when the amount of backscattering is raised to some critical value the steady-state regime becomes unstable due to build-up of one of the relaxation oscillations. Similar stability conditions

of steady-state lasing are obtained for a system consisting of a ring oscillator and linear amplifier. It is shown that we can describe the action of the amplifier on the oscillator in the lowest approximation by introducing an effective feedback factor. The effect of an external monochromatic signal on the lasing kinetics is studied taking backscattering into account. The value of the external force necessary to stabilize the steady-state lasing regime is determined for arbitrary relations of amplitudes and phases of the feedback factors.

50849 Wavenumber measurement of weak CO_2 laser lines around 10.6 μm. Nereson, N.G.; Flicker, H. (Los Alamos Scientific Lab., CA). *Opt. Commun.;* **23**: No. 2, 171-176(Nov 1977).

An experimental method is described in which a tunable semiconductor diode laser and the regular CO_2 laser lines are utilized to measure the wavenumber of CO_2 laser lines to an accuracy of about -+ 5 x 10^{-4} cm^{-1}. Twenty new CO_2 laser lines have been measured over the 943 to 951 cm^{-1} region.

50850 Expansion jet system for gas dynamic lasers. Born, G.; Grosch, G. (to Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (Germany, F.R.)). German(FRG) Patent 2,413,349/C/. 2 Jun 1977. 4p. (In German).

The invention deals with an expansion jet system for gas dynamic lasers of parallel arranged two or three-dimensional Laval nozzles in which the nozzle lamellae between the combustion chamber and resonator are put together in a grid or honeycomb fashion and have an inlet section which, seen in flow direction, ends in Laval nozzles for the higher subsonic region and the supersonic region.

50851 Excitation of sodium-xenon and thallium-xenon gas mixtures by high-power electrical discharges. Leep, D.A. Boulder, CO; Univ. of Colorado (1977). 166p. University Microfilms Order No. 78-08,910.

Thesis (Ph. D.).

Electrical discharges through Na-Xe and Tl-Xe gas mixtures have been studied under the following approximate ranges of experimental conditions: metal-vapor concentration (0.1 to 1) x 10^{16}/cm^3, Xe concentration (0.1 to 1) x 10^{20}/cm^3, gas temperatures ca. 650°K for Na-Xe, ca. 1100°K for Tl-Xe mixtures. The discharges take place between molybdenum electrodes of various shapes in a small cell; the electrical input power density is typically approximately 10^4 W/cm^3. Absolute spectral intensities of fluorescence were measured with spatial or temporal resolution; these data combined with available spectroscopic information yield concentrations of various excited atomic species in the discharges. Theoretical models of these high-power discharges developed by Phelps and colleagues are described and compared with the experiments. The theories predict a positive volt-ampere characteristic owing to electron energy loss during dissociative recombination, and the experimental discharges display such positive-resistance character. The measured conductivities, typically approximately 1 ohm-cm, are much larger than those predicted by a model that includes only a few excited states of the metal atoms; this is consistent with theoretical expectations that higher excited states contribute heavily to the total ionization rate. The possibility that these pulsed high-power discharges may be suitable for the NaXe and TlXe excimer bands is discussed. At present the prospects for the TlXe case are encouraging.

50852 New sputtered metal vapor laser systems. McNeil, J.R. Fort Collins, CO; Colorado State Univ. (1977). 153p. University Microfilms Order No. 78-07,433.

Thesis (Ph. D.).

Several rare gas, metal vapor systems were investigated, and cw laser oscillation was observed at a number of transitions between 8400 A and 2250 A in the singly ionized spectrum of Cu, Ag, and Au. The primary population mechanism of the upper level of the majority of the laser transitions is believed to be charge transfer collisions between rare gas ions and neutral metal atoms. The laser transitions were inverted in a hollow cathode discharge, and the metal vapor necessary for laser action was produced by discharge sputtering of the cathode. Spontaneous intensity, absorption, and transition lineshape measurements have been made on several species in the discharge. A simple rate equation model of the discharge has been developed.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 49700, 50119, 50120, 50130, 50221, 50281, 50283, 50304, 50332, 50531, 50802, 50809, 50953

50853 Critical heat fluxes with the vaporization of sodium from the capillary-porous structures of heat tubes and vapor chambers. Subbotin, V.I.; Ivanovskii, M.N.; Kudryavtsev, A.P.; Prosvetov, V.V.; Sorokin, V.P.; Sorokin, D.N. (Physics and Power Institute, Obninsk). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 853-857(Mar 1978).

The article gives the results of an experimental investigation of the critical heat fluxes with the vaporization of sodium from capillary-porous bodies. In the experiments considerable heat-flux densities were attained, reaching 910 W/cm^2.

50854 Heat transfer to liquid metals in regular arrays of fuel elements. Ushakov, P.A.; Zhukov, A.V.; Matyukhin, N.M. (Physics and Power Institute, Obninsk). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 868-873(Mar 1978).

The possibility of calculating the Nusselt number in arrays of fuel elements by using the universal temperature profile in round tubes is examined. A method of calculating Nu, based on the analogy of local heat transfer coefficients in equivalent plane slits, is given. The analysis of theoretical and experimental data leads to a general equation for a wide range of pitches of triangular arrays of fuel elements with any axisymmetric properties.

50855 Heat transfer to pool-boiling freon from inclined heating plate. Chen, L.T. (National Tsing Hua Univ., Taiwan, China). *Lett. Heat Mass Transfer;* **5**: No. 2, 111-120(1978).

Experimental data obtained for the transfer of heat under nucleate boiling conditions from flat surface at various orientations are presented and discussed. Nucleate pool-boiling data for a flat copper plate in contact with Freon-11 at orientation angles from 0° to 180° are presented. Appropriate values of r and Csf have been determined in conjunction with the Rohsenow equation to represent the various data investigated.

50856 Heat ans mass transfer in the condensation of alkali: metal vapors from gas flows. Aref'yev, K.M.; Borishanskii, V.M.; Ivashchenko, N.I.; Fishman, N.M.; Khomchenkov, B.M.; Remarchuk, B.F. (Leningrad Polytech Inst, USSR). *Heat Transfer - Sov. Res.;* **9**: No. 2, 49-53(Mar-Apr 1977).

Heat and mass transfer in condensation of alkali-metal vapors from flowing gases, when diffusion is controlling and a metal mist is formed in the boundary layer, are examined. Diffusion coefficients for helium, argon and nitrogen containing the monoatomic metal vapors have been determined by means of equations. A relationship defining the diffusion cross section for molecular interactions in flows has been established, based on experimental data. 10 refs.

50857 Heat transfer and pressure loss in annular flow of steam-water mixtures with high vapor content. Dzarasov, Yu.I. (Dagestan Res Inst, USSR). *Heat Transfer - Sov. Res.;* **9**: No. 2, 61-65(Mar-Apr 1977).

The article presents the results of comprehensive measurements of the heat transfer coefficient, pressure drop, water flowrate in the wall layer and of the flow pattern of a steam-water mixture in an internally-heated annulus at pressures of 35 and 70 bar. The results are in satisfactory agreement with other data for annuli. An equation which satisfactorily describes the coeffcient of convective heat transfer to the two-phase flow is presented. A model of dispersed-annular flow is suggested. 7 refs.

50858 Heat pipe. Fries, P. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,515,753/A/. 14 Oct 1976. 9p. (In German).

This patent is concerned with the particular construction of a wick inserted as a cylindrical hollow body into the heat conduction pipe with the aim of increasing the quantity of heat which can be extracted. This well known wick has the task of returning the working fluid condensing at the cold end of the heat pipe by capillary effect of the pores of the wick to the hot end of the pipe. According to the invention, this return path is accelerated by a wick having an area of fine pores and one of coarse pores, where the fine pores (between 5 10 μm) produce high capillary forces and the coarse pores (between 0.1 and 1 mm) produce low flow resistance. Such a wick is formed by winding a band-shaped net onto a mandrel, where a short piece having fine pores precedes a long piece having coarse pores (or possibly a second piece having fine pores is added at the end). The wick wound to the internal diameter of the heat pipe in which it is to be fitted, which is later evacuated carries the evaporated working fluid in the hollow space not occupied by the mandrel. This vapor space is surrounded by a thin layer of fine pores with high capillary force opposite the condensate settling out at the cold end of the pipe. The return of the condensate then takes place against low flow resistance in the much thicker layer of coarse pores. Instead of phosphor bronze the wick can consist of a cylinder of sintered material having large pores, on which a layer or mesh having fine pores is sintered. Steel wool or felt can also be used for the layer having large pores.

50859 Regenerative heat exchanger. Gasthuber, H.; Neubrand, F. (to Daimler-Benz A.G., Stuttgart (Germany, F.R.)). German(FRG) Patent 2,453,961/A/. 20 May 1976. 15p. (In German).

This construction is designed to protect the heat exchanger body ('regenerator') built up of thin ceramic laminations against the

dangers, to which the sensitive laminations sintered at the edges are exposed at high pressure difference between the heat-exchanger media. This is achieved by installing the die-shaped regenerator in a gastight metallic housing, which is subjected to the higher pressure of one of the two media, so that no forces in the direction from the inside to the outside can arise in the regenerator. Also the regenerator is cooled better than previously. The heat stresses between the metallic housing and the ceramic regenerator are compensated by compensators. The sealing surfaces of the flange have ceramic fibers or sealing material underneath and are stressed under spring pressure. The medium at the high pressure e.g. compressor air at 6 atm. gauge, is introduced via an inlet duct into the housing. After build-up of pressure in the housing space surrounding the regenerator, the air flows through an inlet into the laminated group of the regenerator, and leaves this via a pressure-tight internal connection between regenerator outlet and an outlet duct in the housing. The other medium, e.g. waste gas at about 1 atm. gauge, flows directly through the second laminated group in the regenerator. Inlet and outlet of the regenerator are always closely connected with one inlet duct and one outlet duct inside the metal housing.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 50951

SAFETY ENGINEERING

50860 Broad capability seismic simulation facility. Kana, D.D.; Scheidt, D.C. (Southwest Research Inst., San Antonio). pp 195-199 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

A medium-capacity seismic facility has been developed for realistic simulation of earthquake environments, as well as all currently-accepted standard test approximations of such environments. In addition to providing a full-scale capability for performing qualification tests on a variety of components to be used in nuclear and conventional power generating stations, it is particularly suited to the study of structural models subject to scaled seismic excitation. Use of the facility for model experiments involves special requirements which are described. The broad capability of the system includes the simulation of a variety of seismic events, and immediate characterization of these events by appropriate engineering parameters. Independent simultaneous excitation along both the horizontal and vertical axes is included. Excitation signals are provided typically by function generators or actual earthquake events recorded on analog tape. Real-time analyzers are used to provide a rapid plotting of response spectra, power spectral density, and other useful parameters.

VACUUM ENGINEERING

REFER ALSO TO CITATION(S) 50801

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 50801

50861 (BDX—613-1785(Rev.)(Pt.1)) **Drilling miniature holes, Part I.** Gillespie, L.K. (Bendix Corp., Kansas City, Mo. (USA)). Jul 1978. Contract EY-76-C-04-0613. 70p. Dep. NTIS, PC A04/MF A01.

Miniature components for precision electromechanical mechanisms, such as switches, timers, and actuators, typically require a number of small holes. Because of the precision required, the workpiece materials, and the geometry of the parts, most of these holes must be produced by conventional drilling techniques. The use of such techniques is tedious and often requires considerable trial and error to prevent drill breakage, and to minimize hole mislocation and hole diameter variations. An initial study of drill geometries and drilling techniques for producing 0.66—mm-diameter holes in stainless steel and brass indicates that positional tolerances of 50.8 μm can be maintained. With appropriate drills, a size repeatability of +- 2.54 μm can be maintained. Centerdrilling is not required if printed circuit board drills are used. Hole quality depends upon the particular combination of feedrate, drilling technique, and drill geometry used. Spindle speed does not affect hole size or location. Additional research is being performed on this subject.

50862 (BDX—613-1786(Rev.)(Pt.2)) **Drilling miniature holes, Part II.** Gillespie, L.K. (Bendix Corp., Kansas City, Mo. (USA)). Jul 1978. Contract EY-76-C-04-0613. 52p. Dep. NTIS, PC A04/MF A01.

Miniature components for precision electromechanical mechanisms such as switches, timers, and actuators typically require a number of small holes. Due to precision, materials, and part geometry, most holes are produced by conventional drilling techniques. Such techniques are tedious and often require trial and error to prevent drill breakage, and to minimize hole mislocation and hole diameter variations. An initial study of drill geometries and drilling techniques to produce 0.66-mm-dia holes in stainless steel and brass indicates that positional tolerances of 50.8 μm can be maintained. With appropriate drills, a repeatability of +- 2.54 μm can be maintained. An analysis of the strengths and deflection characteristics of the eight drills utilized in this study indicated that the printed circuit board drills and the spiral-flute pivot drills had the most rigid features. This is consistent with the tests of locational and size accuracy. Drills of this size can be fed at feedrates of 25.4 μm/revolution in brass and stainless steel without breaking. Once the drill point starts into the workpiece, the elastic stability of the drill is not a major factor in breakage.

50863 (BDX—613-1787(Rev.)) **Drilling miniature holes, Part III.** Gillespie, L.K. (Bendix Corp., Kansas City, Mo. (USA)). Jul 1978. Contract EY-76-C-04-0613. 82p. Dep. NTIS, PC A05/MF A01.

Miniature components for precision electromechanical mechanisms such as switches, timers, and actuators typically require a number of small holes. Because of the precision required, the workpiece materials, and the geometry of the parts, most of these holes must be produced by conventional drilling techniques. The use of such techniques is tedious and often requires considerable trial and error to prevent drill breakage, minimize hole mislocation and variations in hole diameter. This study of eight commercial drill designs revealed that printed circuit board drills produced better locational and size repeatability than did other drills when center-drilling was not used. Boring holes 1 mm in dia, or less, as a general rule did not improve hole location in brass or stainless steel. Hole locations of patterns of 0.66-mm holes can be maintained within 25.4-μm diametral positional tolerance if setup misalignments can be eliminated. Size tolerances of +- 3.8 μm can be maintained under some conditions when drilling flat plates. While these levels of precision are possible with existing off-the-shelf drills, they may not be practical in many cases.

50864 (SAND—77-1844C) **Effect of distance heuristics and circuit testability on the generation of test vectors for combinational circuits.** Goldstein, L.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1977. Contract EY-76-C-04-0789. 22p. (CONF-780626—1). Dep. NTIS, PC A02/MF A01.

From 15. design automation conference; Las Vegas, NV, USA (19 Jun 1978).

A heuristic decision process based on the use of a distance metric in conjunction with a nine-valued circuit model is shown to decrease the time required to generate complete single-fault-detecting test sets for combinational circuits by as much as 30%. The effectiveness of the heuristics is demonstrated to depend upon a testability measure defined as the number of equivalent two-input gates plus fanouts divided by the sum of circuit inputs and outputs.

50865 Calculation of overvoltages in capacitive energy accumulators. Konotop, V.V. (Khar'kov Polytech Inst im. V.I. Lenin, Ukr SSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 32-38(Oct 1977). (In Russian).

A method of calculation of overvoltages in a capacitive energy accumulator, using oriented graph properties, is worked out. The voltage waves arising in a power conductor are represented by branches of a tree growing in time, i.e., by an oriented graph. By means of "step by step" solution of the oriented graph, the voltage in the power conductor nodes of connection to the accumulator, the load, and the commutator is determined.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 50616

50866 (AED-CONF—77-195-004) **Ceramic coating of studded pipe surfaces in refuse incineration plants.** Stein, H.; Gelsdorf, G.; Schwalb, M. (Vereinigung der Technischen Grosskraftwerksbetreiber e.V., Frankfurt (Germany, F.R.)). 1977. 12p. (In German). (CONF-770695—4). Dep. NTIS (US Sales Only), PC A02/MF A01.

From International conference on fireside corrosion and contamination in thermal power stations; Essen, F.R. Germany (1 Jun 1977).

The boiler surfaces in the firing room of refuse incinerators are usually damaged after a short time by corrosive flue gases and the temperatures in the firing room which are sometimes very high. The damaging mechanism is known and proven by extensive literature reviews. The corrosion damage can be prevented by using ceramic material, essentially in the form of fire-proof masses. This requires determining the sort of construction and materials quality according to each individual case and the conditions expected in the firing room. There are several useful solutions, such as the use of burned fireproof protection elements.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 49505, 49507, 50644, 50646, 50647

50867 Power conservation through proper fan operation. Perry, R.E. *Arch. Energiewirtsch.;* **32**: No. 2, 109-119(Feb 1978). (In German).

This report gives criteria for the choice of particularly effective measures to control fan operation, e.g. through the inlet or outlet nozzle or by controlling the variable speed. The configuration of the inlet and outlet duct has considerable influence on the behavior and output of the fans, the article gives some construction parameters which may be important in optimizing the form of the ducts. Adjustable shutters inside the duct are investigated as a means to optimize blower performance and output. The methods were used for 'fine adjustment' of the blower behavior in order to meet all the requirements of the system.

50868 About the utilization prospects of the pulsating combustion. Severianin, V.S.; Derescuk, E.M. (Bautechnische Hochschule Brest (USSR)). *Arch. Energiewirtsch.;* **31**: No. 12, 1047-1051(Dec 1977). (In German).

A new highly intensive method of fuel firing, pulsating combustion, is dealt with in the USSR. This method has certain advantages prevailing its disadvantages, thus making a technical testing very advisable. A general inquiry was held in the USSR in order to find out the reasons for the very slow introduction of pulsating combustion in the economic system. This essay specificates the questions listed in the questionnaires and their answers. The result of the data obtained and evaluated is analyzed.

50869 Turbo-compressor. Potanin, V.A.; Belinskii, N.A.; Meschgorin, E.A. (to Spetsial'noe Konstruktorskoe Byuro Turbonagnetateli, Pensa (USSR)). German(FRG) Patent 2,416,255/B/. 23 Jun 1977. 7p. (In German).

The invention describes a turbo-compressor of such construction that deformation of the heat protection jacket can have no effect on the shape of the labyrinth ring provided with chambers, because of the assembly and because of its heating in operation, so that the danger of contact between the chambers of the ring and of the compressor rotor is removed. This is achieved constructively by arranging an undivided ring-shaped bush fixed to the housing between the divided ring and the divided heat protection jacket, to which the ring and heat protection jacket are fixed.

50870 Additional equipment for driving machines to increase the output. Chapman, H.R. German(FRG) Patent 2,544,181/A/. 14 Apr 1977. 31p. (In German).

The invention concerns additional equipment for combustion engines to increase the output. A driving system is proposed, where a combustion engine is coupled to a rotating machine, so that the latter provides additional output. The drive of the rotating machine takes place via a heat exchanger system, which absorbs the heat produced by the combustion engine and uses it at high efficiency. Apart from this, a new type of air filter and improved inlet arrangements are part of the total system.

50871 Driving plant. Deutschmann, H. (to Motoren- und Turbinen-Union G.m.b.H., Friedrichshafen (Germany, F.R.)). German(FRG) Patent 2,545,663/A/. 14 Apr 1977. 13p. (In German).

It is the purpose of the invention to guarantee correct operation of low compression Diesel engines, particularly during starting, on no load and part load, without having to accept the disadvantages of previously known processes. A driving plant is described which consists of 2 Diesel engines loaded by wastegas turbo-superchargers. The first engine has a compression ratio of Epsilon >= 12, which ensures safe starting. The waste gas turbo-supercharger, fuel injection and load changing of this engine are designed for optimum part load operation. The second motor is designed for a high load and a compression ratio Epsilon <= 12. The associated waste gas turbo-supercharger can supply the required load pressure on full load operation. The waste gas power not required for loading the first engine is used for the preparation of charging air for the second engine.

50872 Method and device to start a gas generator to convert hydrocarbons into a fuel gas and an internal combustion motor to be fed with the fuel gas. Mentschel, H. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,542,997/A/. 31 Mar 1977. 21p. (In German).

The invention deals with a method as well as an equipment to carry out this method, to start a gas generator for the catalytic conversion of hydrocarbons with an oxygen-containing gas into a fuel gas. The invention also concerns the starting of an internal combustion engine to be fed with the fuel gas. Catalyst material is temporarily treated in a reaction room containing a catalyst filling, a comparatively oxygen-rich mixture of hydrocarbons and air is gassed over the catalyst and is there exothermally converted for further treating of the catalyst filling.

50873 Equipment for positional stabilisation of rotors of large axial steam turbines. Gemein, R.; Wotschofsky, F. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,543,689/C/. 16 Dec 1976. 5p. (In German).

According to the invention, the position of the rotor of a large axial turbine is stabilized by the production of a gravitational force supporting the components. This is achieved by the use of steam power, by an unsymmetrical change of the stator body and at the circumference of the running blades. The stator has a semicircular cut-out opposite each ring of running blades, whose radius, along the stator circumference declines from a maximum at the top to zero below. The stator cut-out is partnered by a trough shaped cut-out in the ring of running blades to a channel, whose cross section is reduced from a full circle above, along the stator circumference, to (a little less than) a semicircle below. Apart from the steam flowing axially through the turbine blades, a small quantity of steam flows via a gap between stator and rotor into the newly formed channel, becomes turbulent there and supplies a centriptal differential pressure head. This pressure is reduced in accordance with the channel crosssection along the rotor circumference from above downwards. The resultant is a vertical upward component supporting gravitational force, which is desirable for stabilisation, particularly in new large turbines with high steam forces compared with the rotor weight.

50874 Firing of a steam raising unit with coal dust and gas burners. Wittchow, E.; Kral, R. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,523,852/B/. 14 Oct 1976. 5p. (In German).

This construction for the combustion space for firing, which is equipped with coal dust burners and with gas burners, should permit simultaneous operation with both types of burners, without adverse effect on the combustion of the coal dust and the radiation conditions in the combustion chamber. In the combustion space of rectangular (nearly square) plan, one or more rows of gas burners are arranged at the bottom opposite one another on the narrow sides of the rectangle. Above these there are 9 or 12 coal dust burners arranged in 3 rows below one another on the wider, sides of the rectangle. With simultaneous firing with both types of burners, a certain part of the coal dust burner is not in operation, e.g. for 9 in three vertical and three horizontal rows of burners, the middle vertical row is not used. With even heating of the combustion chamber walls this avoids interference between the two different flue gas flows. This applies particularly when burning gas of low calorific value, e.g. waste gas from a blast furnace, where large quantities of inert gas are formed. (For a boiler with vertical separating wall, 12 coal dust burners are installed in 4 vertical and 3 horizontal rows. For simultaneous operation with the gas burners the two inner vertical rows of coal dust burners are not in operation.) (HW).

50875 Multi-cylinder Stirling hot gas engine with double acting pistons. Hartmann, R.; Zimmermann, H. (to Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). German(FRG) Patent 2,206,488/C/. 14 Oct 1976. 7p. (In German).

The invention should remedy the existing disadvantages of multi-cylinder Stirling hot gas engines, and create a multi-cylinder Stirling hot gas engine, which for a comparable simple construction makes fast load control possible. This occurs by rotation of the eccentric shaft or by changes of the relative phase position of the circular piston, which produces a simultaneous change of the stroke of all pistons. The principle on which the invention is based can also be applied by reversal of the method of operation, for the construction of multi-cylinder Stirling cycle refrigerators.

50876 Gas turbine with self-contained ceramic turbine rotor. Stegherr, R.; Mathiak, D. (to Motoren- und Turbinen-Union G.m.b.H., Muenchen (Germany, F.R.)). German(FRG) Patent 2,510,287/A/. 16 Sep 1976. 13p. (In German).

This construction is designed to overcome the difficulties which occur in the solid connection of a ceramic rotor, e.g. of a small gas turbine, with the compressor from different thermal expansion and brittleness of ceramic material and steel. The suggested separation of the following problems leads to success: holding, centering, transferring the torque. For this purpose the ceramic rotor as a solid body is provided with journals at both ends, which run in self-contained oil or air lubricated sliding bearings or roller bearings. The ceramic journal bearing on the compressor side ends in a ceramic polygon, which is surrounded by a suitably shaped end of a hollow shaft solidly coupled to the compressor shaft. For multi-stage turbines the ceramic rotors can be supported in bearings separate from the adjacent rotating components in this way. The torque is transmitted by a form-locking polygonal ceramic body to the compressor in both cases. By suitable choice of the direction of flow or suction in the turbine or compressor, the mutual axial thrusts largely cancel out. An axial bearing on the turbine side is no longer required; a small resultant axial thrust is transmitted by the hollow shaft to a compensating piston in the compressor.

50877 Process for manufacturing a turbine blade body. Bird, J.R. (to Rolls-Royce Ltd., London (UK)). German(FRG) Patent 2,302,202/B/. 16 Sep 1976. 7p. (In German).

This addition to main patent P 21 54 480.9 treats particular manufacturing conditions for hot pressing e.g. of nozzle guide blade for gas turbine jet engines and lays down the sequence of the pressing processes. The basis for the main patent was the knowledge that the hot pressing of a part with sections of very different wall thicknesses is not possible in one stage, as no homogeneous structure is to be produced. The following stages lead to the achievement of the required high quality: Filling silicon nitride power into a mould in the shape of the thin walled pressed casting, here the aerodynamic profile of the blade. Pressing at about 85 kg/sq. cm at about 1750°C. Putting this pressed part into a second mould in the shape of this part for the one-sided or two-sided blade ring section. Filling the remaining empty spaces with the same powder. Final pressing, i.e. simultaneous production of further blade parts and firm connections with the first pressed part of the same structure. To fasten the complete blade for assembling the machine, suitable fasteners such as flanges, bars, openings, dowels can be worked into the shape of the mould and pressed in the final stage.

50878 Power plant with gas turbine and a heat exchanger in the working circuit of the gas turbine for cooling the working gas. Heller, L.; Forgo, L.; Szabo, Z. (to Energiagazdalkodasi Intezet, Budapest (Hungary)). German(FRG) Patent 2,550,450/A/. 10 Jun 1976. 13p. (In German).

This patent is concerned with an appreciable improvement of the efficiency compared with a normal power plant with a closed cycle gas turbine. This should amount to a calculated 7 to 15%, where it is particularly important that the many ancillary pieces of equipment should be able to work at their optimum values. This is to be achieved by introducing a second closed cycle equipped with a condensate steam turbine. Both circuits are only coupled by a heat exchanger, by which the waste heat of the working gas of the first circuit is transferred to the second circuit, and is taken at a constant controlled pressure to an evaporator. The vapor space of this is connected back to the heat exchanger coupling the two circuits, via the steam turbine, and the liquid space is connected back to the coupling heat exchanger via an air cooler. The turbine waste steam passes through a surface condenser or a mixing condenser if required. By including a wet cooling tower and a subsequent cooler the water requirement can be reduced by 50 to 75% compared to plants where only evaporation cooling towers are used. By extracting some steam whose pressure has been reduced from an intermediate stage of the turbine and returning it via a further evaporator, the thermal economy should be further improved.

50879 Heat exchanger for a gas turbine. Hagemeister, K.; Hueller, J. (to Motoren- und Turbinen-Union G.m.b.H., Muenchen (Germany, F.R.)). German(FRG) Patent 2,453,932/A/. 26 May 1976. 19p. (In German).

This patent is concerned with a simplification of the removal and assembly of rotating heat exchangers for maintenance. This should considerably reduce the time required for maintenance, which arises during the frequently necessary inspection of highly stressed rotating ceramic discs and their bearings and seals, as previously the whole power plant had to be dismantled and reassembled for this purpose. The solution consists of creating a 'heat exchanger cover assembly'. There the heat exchanger with all moving and wearing parts is installed in removable covers of the heat exchanger housing. A series of constructional measures ensures exact adjustment of all parts and meshing of the drive on reassembly. Such measures include, among others: Supporting the porous ceramic disc on a central journal bearing, into which supporting bolts are inserted from the outside. Outer bearing supporting the rotor, in the form of a solid disc, via several backing bearings on the outside edge, one of them being a driving pinion. Stub shaft for making the connection between the disc and the pinion. Hold-back plates which prevent the emergence of seals when the cover is removed. Spring-supported tilting lever to ensure position of ceramic disc when removing cover.

50880 Heat exchanger. Thurley, J. (to Thurley (J.) Ltd., Harrogate (UK)). German(FRG) Patent 2,518,836/A/. 6 Nov 1975. 15p. (In German).

This heat exchanger, which heats and evaporates a working fluid with the combustion gases of a burner by a heat exchange fluid, is meant to improve the efficiency considerably by including the container containing the heat exchange fluid, as the radiated heat of the burner, which is otherwise lost, is used in this way. As the hottest parts of the burner and the adjacent distribution channel for the combustion gas are cooled by the heat exchange fluid, the cladding of the burner in fire-resisting material becomes unnecessary. The weight and cost are reduced, and the life of the burner and the accesibility of all parts are improved. A horizontal square outer container contains a similar inner container open at the top of half the length and width of the outer container. The two communicating containers are filled to half their height with the primary medium. An upper and lower chamber, both fed axially with fuel, form the burner together with a connected coaxial turbulence chamber. The greater part (of the burner) and the connected horizontal distribution channel are below the level of the cooling primary. The pipe bundle has the combustion gases, rising from the lower distribution channel and the primary fluid heated by these gases flowing through it and is heated by them, where the secondary medium evaporates. The waste gases rising from the primary medium leave the outer container by two chimney openings at the top of the outer container. The maximum heat emitted per hour is stated to be about 100 million KJoules - compared to about 72 million KJoules according to the previous state of technology. The 180kw approx. of blower power previously required to produce the second output is reduced to about 110kw.

50881 Turbine. (to Koninklijke Machinefabriek Stork N.V., Hengelo (Netherlands)). German(FRG) Patent 2,345,637/A/. 27 Mar 1975. 11p. (In German).

The construction fulfils the purpose of standardising some main parts of a centripetal axial turbine as standard parts, while other smaller parts affecting the operating parameters are made and installed specially for each case. The upper and lower halves of the turbine housing are made as standard parts. They contain the bearing bushes and a number of guiding blades for several axial stages, between which the centripetal stage is symmetrically positioned. An inner housing centered on the inside of the turbine housing and containing the centripetal stage consists of two horizontally divided identical halves. A distribution channel with radially decreasing rectangular cross section is fitted inside its circumference. The medium is fed into this channel tangentially by 2 valves, whose housing is supported in the turbine housing. These controlling valves for the turbine output open into a replaceable part containing the valve seat, which is connected to the distribution channel via an expansion gap. For different requirements, e.g. for medium pressure, speed, output, only a few parts, such that carrying the valve seat, have to be specially made.

UNDERGROUND ENGINEERING

50882 Shield driving machine. Follert, H.G.; Beyer, A. (to Gewerkschaft Eisenhuette Westfalia, Luenen (Germany, F.R.)). German(FRG) Patent 2,259,249/B/. 2 Jun 1977. 6p. (In German).

The invention concerns face driving machines, which have an inner and an outer shield. The cutting head with drive and accessories are accommodated in the inner shield. The inner shield is supported by the outer shield and is movable axially according to mining progress. In order to be able to support the tunnel crossection without a break for great driving progress, the outer shield is divided into two equally large covering parts, which consist in part of a multiple radius piece, and of axially movable individual planks. These are collected in groups and moved together. A group is therefore coupled to the inner shield and moved while supported by this, while a second group of the former can be moved in stages. Further claims describe advantageous types of design of support, of guiding members of the constructional arrangement and the interaction of the various parts of the machine during operation.

50883 Bar construction for face support. Pollard, T. (to Gullick Dobson Ltd., Wigan (UK)). German(FRG) Patent 1,947,378/B/. 26 May 1977. 5p. (In German).

50884 Knife shield, especially roof shield for the development of underground cavities. Foik, A. (to Gewerkschaft Eisenhuette Westfa-

lia, Luenen (Germany, F.R.)). German(FRG) Patent 2,314,703/B/. 14 Apr 1977. 8p. (In German).

The roof shield consists of a number of supporting planks with parallel axes supported on frameworks. The supporting frameworks are moved in alternate pairs by advance cylinders. Several supporting frame components connected by joints form a flat roof. According to the invention the knife planks are connected in two groups, preferably, which are fastened to one supporting framework each. The supporting frameworks are supported by cylinders on working shoes, which are on longitudinal movable bearings. Together with the tension belts acting on the tension frame halves, this arrangement permits the setting of the support width of the protective shield.

50885 Bolting construction frames used for underground mining. Schaefer, H. German(FRG) Patent 2,542,911/A/. 31 Mar 1977. 7p. (In German).

50886 Hydraulic feed arrangement for knife shield driving in drift driving or driving tunnels etc. Trott, R. (to Gewerkschaft Eisenhuette Westfalia, Luenen (Germany, F.R.)). German(FRG) Patent 2,239,565/B/. 3 Mar 1977. 7p. (In German).

In the knife feed of faces, the knife supports, which are distributed over the circumference of the feeding frame, are driven forward hydraulically by cylinders fixed to the support frame. This can lead to tilting and/or jamming of the frame, as one cannot produce an even distribution of power over the cylinder. To reduce these difficulties, it is proposed in the invention that the feed cylinders should be combined in three equally distributed groups. Each group has its own pressurizing intake, by which the individual cylinders are inter-connected. A single pump can be provided for each group. It is also possible to let the pressurising supply through on alternate sides from one pump. The return path of the pressurising medium is kept to a minimum pressure for each group by a braking device (e.g. throttle or braking valve). The pressure can also be controlled by a throttle valve.

50887 Geophysical detection of disused mineshafts in the Newcastle Upon Tyne area, N.E. England. Dearman, W.R. *Q. J. Eng. Geol.;* **10**: No. 3, 257-269(1977).

The ground conditions associated with abandoned mineshafts are reviewed. Both the resistivity and magnetic geophysical methods have been applied to the search for old mineshafts. Magnetic methods are preferred because they can be applied to the occasionally difficult terrain conditions likely to be associated with disused shafts. Two case histories of the application of the magnetic method in the Newcastle Upon Tyne area are given in detail.

50888 Filter for underground mining for suction of preferably full cut and part cut machines, to be provided with preheated air, to avoid dropping below the dew point. Hoelter, H. German(FRG) Patent 2,516,767/A/. 28 Oct 1976. 7p. (In German).

Particularly when cutting hard rock, the cutting room to be provided with suction is wetted with water from nozzles, which, when sucking out air containing dust with high humidity leads to encrustation in the filter cloth. In order to avoid this, it is proposed that the air should be heated, using heat from the motor driving the ventilator, so that one avoids dropping below the dew point in the filter.

50889 Face support with shield supports. Doermann, H.J. (to Bochumer Eisenhuette Heintzmann und Co. (Germany, F.R.)). German(FRG) Patent 2,417,223/B/. 30 Sep 1976. 10p. (In German).

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 50825

50890 Method and equipment for supporting an ascending pipe of an underwater bore hole. Jones, H.W. (to Regan Offshore International, Inc., Torrance, Calif. (USA)). German(FRG) Patent 2,625,520/A/. 12 May 1977. 21p. (In German).

The proposed equipment should provide rising pipes even at great depths (up to about 1800 metres) (as required for underwater natural oil bores) which lead from a water vehicle to the ocean bed and which a) largely independent of the movement of the water vehicle, remain vertical, b) create an even support for the inertia forces during sinking, which are carried by the water vehicle and c) guarantee a constant load on the rising pipe. The use of a gimbal suspension in connection with hydraulic compensation equipment is proposed for this. The upper part of the gimbal suspension acts as support for the rising pipe flanges projecting over the rotating table, and the lower part is supported on the water vehicle. Numerous other claims and examples include the detailed mechanical construction of the gimbals, the hydraulic cylinder with pressure compensation and the carrying out of working processes.

50891 Instrumentation for offshore structures. Geminder, R.; Pomonik, G. (Mechanics Research, Inc., Los Angeles). pp 357-370 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

At the present time many structures used in offshore exploration are instrumented to assist in the design and safety of these structures. The more recent structures have onboard computers which are used to collect data and control the operation of the rig. Many structural failures caused by the severe offshore environments have created a need for obtaining data to improve the design and try to eliminate these very costly accidents, causing a loss of over 200 million dollars. Half of these accidents were caused by the severe offshore environment. Thus, there is a great need to improve the design criteria for the offshore structures. There is also a need for hazard warning systems. Instrumentation can provide the type of information needed to minimize accidents. Various instrumentation techniques used in the many severe environments throughout the world are discussed.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 50519, 50989

50892 Emission control to modern monitors-stay in-line. Klarenberg, A. *Process Eng.;* 56-57(Apr 1978).

Operators of incinerators, power plants, diesel-engine generators and other fuel burning installations are faced with a growing need to analyze the chemical composition of gaseous and particulate emissions from stacks and ducts. This need has been stimulated by the necessity to meet emission standards laid down by environmental control authorities, and also by the ever present practical desire to minimize the consumption of increasingly expensive fuel by optimization at the burners. Two simple new in-situ stack emission monitor/analyzers which eliminate the need for sampling systems and are fast enough to offer real-time control are discussed.

50893 Smoke separators to reduce air pollution. Eber, M. (Monsanto Research S.A., Zurich (Switzerland)). *CZ-Chem.-Tech.;* **6**: No. 12, 523-527(Dec 1977). (In German).

The precipitation of aerosol particles from smoke is an essential part of keeping the air clean in many industries in which smoke is produced. The basic concepts of air pollution are firstly dealt with as well as the methods to remove it from room air. To follow, various types of smoke separation are looked at. Finally, a few application fields of smoke separator systems are gone into, especially sulphuric acid plants, fertilizer industry and textile industry.

50894 More effective removal of dust by less turbulent ventilation and filtration of suspended matter. Gail, L. (Farbwerke Hoechst A.G., Frankfurt am Main (Germany, F.R.). Ingenieur-Forschung und Entwicklung). *Zentralbl. Arbeitsmed. Arbeitsschutz;* **27**: No. 12, 297-302(Dec 1977). (In German).

The task and problems involved for the effective determination and deposition of fine dust emissions are discussed and possibilities for a more effective dust removal by less turbulent ventilation and the filtration of particulates are presented.

50895 Planning of waste water combustion plants. Hoerner, G. (BASF A.G., Ludwigshafen am Rhein (Germany, F.R.)). *Waerme;* **83**: No. 5, 77-87(Oct 1977). (In German).

Thermal oxidation, i.e. waste water combustion, is an advantageous and necessary alternative to the biological waste water treatment for many process waste waters. Besides physical-chemical properties of the process residue and the combustion products arising from the thermal oxidation, the additional heat required for a plant plays an outstanding role in the total economy. A whole range of influences must be considered in the decision for the selection amongst many process variants. The systematics indicated in this article enables a certain ordering and can thus be a decisive help to the planning engineer as to how he should solve his problem to an optimum.

50896 Rapping shaft drive assembly for electrostatic precipitators. Hueppi, X.J. (to Elex A.G.). US Patent 4,036,610. 19 Jul 1977. Filed date 23 May 1975. 4p.

A rapping shaft drive assembly for electrostatic precipitators is described that includes a rotatably mounted isolator disposed between a rapping shaft and rapping shaft support means, the isolator including heat means and the support means including at least two rollers in communication only in points with the isolator

whereby heat transmitted from the heated isolator to the rollers is minimized.

50897 System to clean dust-charged waste gases. Fiedler, H. German(FRG) Patent 2,543,216/A/. 31 Mar 1977. 17p. (In German).

A system is described to clean dust-charged exhaust gases which works by introducing the crude gases into the upper part of a standing shaft and by pressing the gases downwards into a trough continuously flowed through by fresh water. The shaft ends over the trough and is placed together with the lower shaft section in gas chamber connected to a chimney.

50898 Method and equipment to separate hydrogen sulfide and nitrogen oxides from gases. Powlesland, W.H.; Smith, J.W.; Harper, P.H.I.; Knight, C.H. (to Powlesland Engineering Ltd., Rexdale, Ontario (Canada)). German(FRG) Patent 2,637,925/A/. 31 Mar 1977. 11p. (In German).

A method is described to remove H_2S and nitrogen oxides from waste gases which are added in counter-current to a catalyst-acting bulk material of porous hematite pellets. The bulk material is coated with a silicate material with the help of the gas to be purified; the sulfer deposited on it in the reaction can be rubbed off and the bulk material thus regenerated may be used again.

50899 Fine vacuum distillation plants in the light of environmental control. Stage, H. *Seifen-Oele-Fette-Wachse;* **103**: No. 6, 151-154(1977). (In German).

In connection with distillation plants and fractionation in the field of medium high vacuum, environmental protection investments for maintaining clean water and air standards and noise abatement gain in importance. However, appropriate switch mechanisms and construction of the various elements required for distillation make it possible to meet the demands of environmental protection while keeping the operating costs low. Illustrated by the example of fatty acid distillation, it is explained on the basis of the distillation elements developed by the Arbeitsgemeinschaft Chemische Verfahrenstechnik how the present legal requirements concerning waste water, waste air and noise development can be met even under exacting conditions. Measures start already with degassing and drainage. Furthermore, gentle vaporization without inerts from dry distillation, and condensation which avoids cloud formation owing to undercooling are necessary. With regard to noise development, pumps, control devices, air condensers and vacuum aggregates are included in the investigations.

50900 Method to purify waste gases containing nitrose. Zeininger, H.; Malow, E.; Rosenfelder, J. (to Farbwerke Hoechst A.G., Frankfurt am Main (Germany, F.R.)). German(FRG) Patent 2,524,984/A/. 16 Dec 1976. 7p. (In German).

A method is described to remove nitrogen oxides from waste gases. Particularly larger amounts of nitrogen oxides may also be simply and cheaply removed from waste gases as occur in, e.g., the production of nitric acid or fertilizers. The basis of the method is that the waste gases are passed in counter current through a basic thiosulphate solution (sodium, potassium, ammonium, thiosulphate), e.g. through a bubble-cap column, in which the pH value is between 8 and 12; the molecular ratio of the thiosulphate to the nitrogen oxides is between 0.4 and 1.5 to 1. In this method in which the initial content of nitrogen monoxide can be up to 70%, final purities of below 100 vol ppM nitrogen oxide are obtained. The waste air released in the method is free of SO_2.

50901 Process for purifying exhaust air. Stammann, D.; Kerckow, A.; Bachmann, G. (to BASF A.G., Ludwigshafen am Rhein (Germany, F.R.)). German(FRG) Patent 2,512,449/A/. 7 Oct 1976. 7p. (In German).

A process for purifying exhaust air, which contains transient organic products, by washing with a liquid is discussed. The exhaust air is washed with an aquaeous polymeride dispersion. The exhaust air is sucked through a flow of the polymeride dispersion with simultaneous mixing, the mixture of exhaust air and polymeride dispersion is separated and the polymeride dispersion, after removing and replacing part of it by fresh polymeride dispersion, is used as a flow medium to suck in the exhaust air.

50902 Method to remove sulfur dioxide from gas flows. Mandelin, D.L. (to Occidental Petroleum Corp., Los Angeles, Calif. (USA)). German(FRG) Patent 2,348,145/A/. 24 Apr 1975. 21p. (In German).

A method is treated to remove sulfur dioxide from gas flow, particularly from waste gases and chimney gases. The gas flow is brought into contact with at least one molten inorganic thiocyanate as absorbent. A temperature-stable SO_2 reactionable substance, a base, oxidation or reducing agent, an alkali^{-3}ulphit^{-1} carbonate or quinone as additional substance is added to the thiocyanate in amounts of 10^{-} 3 to 10^{-} 1 mol per mol thiocyanate.

POWER CYCLES

RANKINE

REFER ALSO TO CITATION(S) 49920, 49921

50903 Rankine system simulation on a small computer. Gimstedt, L. (Saab-Scania AB, Linkoeping, Sweden). pp 427-444 of UKSC 78. Proceedings of the 1978 UKSC conference on computer simulation. Surrey, England; IPC House (1978).

From UKSC conference on computer simulation; Chester, UK (Apr 1978).

See CONF-780439—.

In the development of new designs, simulation, combined with hardware tests, is a powerful tool. The demands for flexibility of such a tool make it desirable to work with an interactive system on a small computer. This leads to various problems with memory space and execution time. An example is given of how to cope with these problems, in simulating the vapor generator of a small Rankine propulsion engine.

PARTICLE ACCELERATORS

50904 (LA—7265C) **Space charge in linear accelerators workshop.** Jameson, R.A. (ed.). (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 174p. (CONF-771171—). Dep. NTIS, PC A08/MF A01.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

Nineteen papers and three summary sessions (theoretical, simulation codes, and experimental approach) are presented on the effects of space charge in linear accelerators. A separate abstract was prepared for each paper for inclusion in Energy Research Abstracts (ERA). (PMA)

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 50919

50905 (LA—7203-MS) **Overview of LAMPF and its accomplishments.** Rosen, L. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1978. Contract W-7405-ENG-36. 35p. Dep. NTIS, PC A03/MF A01.

The report presented is from a talk given at a Los Alamos Scientific Laboratory colloquium on October 4, 1977, in which the history, technological accomplishments, present status, and scientific program at the Clinton P. Anderson Meson Physics Facility (LAMPF) were reviewed.

50906 (LA—7265C, pp 134-135) **APF structures.** Swenson, D.A. (Los Alamos Scientific Lab., NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

In the PIGMI program at LASL, plans have been made to use a short section of alternating phase-focused (APF) linac in the very beginning of the machine. The APF will be a bridge between a low injection energy and the quadrupole-focused drift-tube linac structure which has all the properties needed for many applications. The space-charge capabilities of the APF structure are briefly discussed.

50907 (TID—28505) **Cyclotron Laboratory Experimental Nuclear Science Program. Final technical report, January 1, 1975—June 30, 1976.** (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Feb 1978. Contract EY-76-C-05-4856. 45p. Dep. NTIS, PC A03/MF A01.

A discussion is given of operations and research during the period January 1, 1975 to June 30, 1976, at the University of Maryland Cyclotron. The main effort in nuclear chemistry was associated with nuclear reactions at intermediate energies, radioactive decay, fission at intermediate energies and development of nuclear methods of analysis. The main effort in the nuclear physics research program was associated studies of nuclear scattering and reactions, quasi-free scattering and reactions, pion production, and gamma-ray production. The main effort in cyclotron operation was associated with operation and maintenance of the cyclotron facility for the nuclear chemistry and nuclear physics research program.

50908 Preliminary study of the accelerator--breeder concept. Lewis, R.A.; Lam, P.S.; Khan, E.U.; McCarthy, P.B.; Stahl, D.;

Parker, E.F. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 754(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50909 Linear accelerator driven and regenerative reactor systems. Grand, P.; Powell, J.R.; Steinberg, M.; Takahashi, H. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **28**: 757-758(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50910 Electro-nuclear fuel producer. Malenfant, R.E. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 758-759(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

50911 Uranium and thorium fuel cycle in linear accelerator driven and regenerative reactors. Takahashi, H. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **28**: 759-760(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

50912 (LA—7265C, pp 4-10) **Experimental results: experience with beam current and emittance in the Fermilab linac.** Curtis, C.D. (National Accelerator Lab., Batavia, IL). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

A review is given of some of the results from the Fermilab 200-MeV Alvarez linac over the past several years, some comparisons are made with other Alvarez linacs around the world in terms of beam emittance growth and momentum spread, and recent experience with accelerating negative ions is discussed. There is a fairly general agreement with respect to the increased emittance, that is, dilution in phase-space density as the beam goes through the linac. This will vary all the way from a factor of 2 to perhaps 6 depending on the input emittance, among other things. There seems to be some indication that the smaller the input emittance to the linac the bigger the growth factor in the emittance during acceleration. So one does not gain at the output of the linac as fast in reduction of emittance as one gains in reducing emittance at the ion source.

50913 (LA—7265C, pp 11-23) **Transverse emittance measurements for the 201-MHz linac at LAMPF.** Stevens, R.R. Jr. (Los Alamos Scientific Lab., NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

Extensive beam studies were carried out during the past year as part of an ongoing effort to bring the LAMPF accelerator to its design intensity. The question of the damping of the beam emittance in the 201-MHz, 100-MeV linac is of particular importance because the total emittance of the beams now being obtained from this linac are already comparable to the admittance of the subsequent accelerating structures and will increase as the peak current accelerated is raised. The basic question now to be answered in order to bring LAMPF to 1-mA average current operation, is how to prepare and subsequently accelerate beams in the 201-MHz linac that can be accepted in the remaining structures with the beam spill levels desired. Beam emittance data for H^+ and H^- ion beams are presented and discussed.

50914 (LA—7265C, pp 24-35) **LAMPF beam profile measurements.** Sander, O.R. (Los Alamos Scientific Lab., NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

Efforts to study beam tails or halos at the LAMPF linac using wire scanners are discussed. The operation of the wire scanners is described, and data analysis using three Gaussians to fit the beam is delineated. Beam profiles and beam profile area vs beam energy data are given. (PMA)

50915 (LA—7265C, pp 36-50) **High beam current operating experience at BNL.** Witkover, R.L. (Brookhaven National Lab., Upton, NY). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

The machine layout and recent modifications of the BNL 200 MeV linac are discussed, and beam emittance in the AGS is described. Beam profile data are presented, and BNL linac performance is outlined. The BNL linac runs as a constant brightness machine as the current is normally adjusted (anode pulser). Operation at 100 mA results in higher radiation but within acceptable limits; this can be reduced with further tuning. The momentum spread at the linac is not increasing from 50 to 100 mA. More low-high energy measurements and bunch length measurements are needed.

50916 (LA—7265C, pp 71-75) **Calculational approaches to emittance growth.** Gluckstern, R.L. (Univ. of Maryland, College Park). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

A brief review of calculation methods of the six-dimensional problem of beam emittance growth in particle accelerators is given. The problems of using projections onto various planes and of distribution stability are discussed. (PMA)

50917 (LA—7265C, pp 76-81) **Equilibrium distributions.** Lysenko, W.P. (Los Alamos Scientific Lab., NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

A discussion is given of a calculation method for beam matching into a linac taking into account the space charge forces, which is a six-dimensional problem in phase space. Results for beam emittance, bunch radius, and space-charge parameter are shown. (PMA)

50918 (LA—7265C, pp 82-89) **Stability of K-V distributions.** Smith, L. (Univ. of California, Berkeley). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

The mathematical procedure is sketched for using the Kapchinsky-Vladimirsky distribution for stability analysis of beam transport including space charge in which the external restoring forces vary with distance. Stability diagrams are given for several cases. (PMA)

50919 (LA—7265C, pp 90-96) **Choice of accelerator parameters.** Batchelor, K. (Brookhaven National Lab., Upton, NY). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

The results from the Kapchinsky-Vladimirsky distribution are used to determine beam parameters that are relevant to the design of a practical accelerator, in particular, the initial operating parameters. Maximum beam currents, matched beam parameters, longitudinal beam quality, and phase damping are given and discussed. (PMA)

50920 (LA—7265C, pp 97-98) **Bunching and focusing systems.** Jameson, R.A. (Los Alamos Scientific Lab., NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

A brief review is given of some recent work in beam bunching and focusing in particle accelerators. (PMA)

50921 (LA—7265C, pp 99-107) **Beam dynamics computer codes.** Crandall, K.R. (Los Alamos Scientific Lab., NM); Weiss, M. May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

A discussion is given of computer programs used in: (1) accelerator design, in particular linear optimization programs; and (2) linear accelerator adjustment and running. Operation on-line programs at LAMPF and CERN are described, and results are shown for the longitudinal phase space, dynamics parameters variation, simulated beam motion, vertical beam emittance, and the beam envelope. (PMA)

50922 (LA—7265C, pp 108-115) **Space-charge calculations with the fast Fourier transform.** Vaughan, J.R. (Litton Industries, San Carlos, CA). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

A method is described for calculating linear accelerator beam trajectories in traveling wave tubes. A grid is placed over the region of interest in which there is space charge. A matrix of the Fourier potential coefficients is obtained, and a straight Fourier synthesis is used to add these with the appropriate trigonometric multipliers to obtain the potential matrix. The pulses on a particle for the next trajectory step are found by interpolating and differencing the potentials on that matrix. (PMA)

50923 (LA—7265C, pp 116-122) **Multi-specie beam transport by rms statistics.** Emigh, R.C.; Armstrong, D.D. (Los Alamos Scientific Lab., NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

Calculations are discussed on beam transport for an intense neutron source which is going to be a radiation damage facility for the fusion energy program at LASL. The multiple species program and the development or generalization of the rms calculations may have some utility in understanding some of the dynamics of the way in which space-charge neutralizatin actually occurs. The rms approach for a single species is briefly sketched, and the generalization to several species is shown. (PMA)

50924 **Ion beamlet steering by aperture displacement for a tetrode accelerating structure.** Gardner, W.L.; Kim, J.; Menon, M.M.; Whealton, J.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Rev. Sci. Instrum.;* **49**: No. 8, 1214-1215(Aug 1978).

Steering of a single beamlet of ions in a tetrode accelerating structure as a function of both aperture displacement and the ratio of acceleration to extraction voltage (Γ) has been measured, and the results are compared to the steering predicted by a modified linear theory. Although the data contain the predicted features of (1) null steering for a particular value of Γ and (2) a directional change in steering through this point, the steering was also observed to be nonlinear in nature. A conjecture as to the cause of this nonlinearity is given, and the implications of these findings to beamlet steering in a multibeamlet source are discussed.

50925 (LA-tr—78-42) **RT (radiotechnical) adjustment of linac accelerating system for URAL-15.** Golubkov, V.P.; Klokov, V.V.; Sevost'yanov, V.S.; Stepanov, V.B.; Teplyakov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1978. Translation of IFVE-INZH—76-138, 1976. 10p. Dep. NTIS, PC A02/MF A01.

The structure of the main units of the accelerating system is presented. The method for experimental study of the accelerating system with H-cavity is briefly reported. The distribution of the strength of the accelerating field in the accelerating system gaps is given. The nominal mean strength of field of 160 kV/cm was obtained. The breakdown occurs at 200 kV/cm.

AUXILIARIES AND COMPONENTS

50926 (BNL—24349) **Proportional wire chamber system for beam definition in precision total cross section measurements.** Carroll, A.S.; Chiang, I.H.; Kycia, T.F. (Brookhaven National Lab., Upton, N.Y. (USA)). Mar 1978. Contract EY-76-C-02-0016. 28p. (CONF-780235—4). Dep. NTIS, PC A03/MF A01.

From Wire chamber conference; Vienna, Austria (14 Feb 1978).

A PWC system was developed and extensively used in precision measurements of total cross sections at low momenta (0.4 to 1.1 GeV/c) and at high momenta (23 to 370 GeV/c). This "electronic collimator" operated simultaneously in a fast (250 nsec) decision making mode, and a slower (0.5 msec) readout mode. The decision making mode utilized adjustable hard-wired logic to define acceptable incident beam trajectories and reject multiple beam tracks. A sample of the events were read into an on-line computer for beam tuning, for chamber diagnostics, and for study of the effect of small angle scattering to verify the total cross section extrapolation procedure.

50927 (LA—7265C, pp 123-133) **Some new accelerating structures for high current intensity accelerators.** Manca, J.J. (Los Alamos Scientific Lab., NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

Future designs of high-energy, high-intensity linear accelerators will probably be different from the present designs of low-current linacs. The linear concept will obviously remain the same, but the accelerating and focusing devices and overall layout of the accelerator can be significantly changed. The possibilities of improving the accelerator efficiency and solving other problems connected with the high-energy and very low energy part of the accelerator are considered. Topics discussed include: (1) the side-coupled accelerating structure; (2) the disk-and-washer structure; (3) the use of the rf field in the cavity for transverse focusing by shaping the cavity noses; (4) low-beta structures using rf focusing and; (5) structures using H-type resonators.

50928 (SLAC-TN—77-7) **rf drive system notes.** Farkas, Z.D. (Stanford Linear Accelerator Center, Calif. (USA)). 30 Sep 1977. Contract EY-76-C-03-0515. 12p. Dep. NTIS, PC A02/MF A01.

A working paper presents opinions and ideas with respect to the operation of SLAC. The recommendations discussed are to: (1) build and test with beam the modulation system shown; (2) buy counters or convert present counters to work with (long) pulse signal; (3) set up test to obtain single multiplier phase vs. input power; (4) perform en masse and in situ phase tracking with +- .1 db variation of MB output, using the beam induced rf as reference; (5) build multiplexer to monitor side-band and harmonic output where only 476 MHz should exist; (6) install cables and coupler as shown to check multiplier tracking in situ without beam; (7) install DSSC modulator and sample and hold-forever circuit to monitor phase across multipliers; (8) replace MO vacuum tube final amplifier with solid state (Hughes) amplifier, also, since the variable frequency feature of the MO is hardly ever used, replace it with a commercial crystal controlled oscillator; (9) find a new, improved varactor diode; (10) using a pulsed input, tune multiplier, and measure absolute phase and phase tracking as a function of peak power; (11) use SPEAR control room spectrum analyzer for monitoring MDL output also.

50929 (UCID—17838) **Quadrupole vs solenoidal focusing to suppress the image displacement instability in linear induction electron accelerators.** Neil, V.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jun 1978. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

The effectiveness of quadrupole vs. solenoidal focusing in suppressing the image displacement instability in linear induction electron accelerators is discussed. A brief explanation of the instability is presented; a criterion is derived for the magnitude of the solenoidal magnetic field required to suppress the instability. Two quadrupole arrangements are treated, and criteria derived for the magnitude of the pole-face field required to suppress the instability. For one arrangement the required pole-face field is less than one-half the required solenoidal field, suggesting that quadrupole focusing may have a practical advantage.

50930 **New 200 MeV line to BLIP at AGS.** Lee, Y.Y. (Brookhaven National Lab., Upton, N.Y. (USA)). *Nucl. Instrum. Methods;* **148**: No. 1, 1-4(1 Jan 1978).

A new beam transport to the Brookhaven Linac Isotope Production facility (BLIP) has been constructed. The use of low Z material in the transport vacuum chamber and elimination electrical feed-throughs, as well as increased vacuum chamber size, has proved effective. The optics were improved by making total momentum recombination. The system has proven to be suitable for the high current, and shown to be very reliable with very little residual radioactivity.

ION SOURCES

50931 (LA—7265C, pp 51-58) **Computer simulation and experimental results for a 130 kV, 80 mA deuterium ion beam.** Boers, J.E. (Sandia Labs., Albuquerque, NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

The results of a computer simulation of the performance of a duopigatron ion source are given and compared with experimental results. The computer program alternately computes trajectories through a device and relaxes the voltages using the space charge generated by the trajectory computation. (PMA)

50932 (LA—7265C, pp 59-60) **Design and test of high current dc ion sources.** Grand, P. (Brookhaven National Lab., Upton, NY). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

The results of a 100 h c-w test of a 620 mA dc ion source are briefly discussed. It was found that, once the discharge was triggered, the filament was no longer needed and could be completely turned off. (PMA)

50933 (LA—7265C, pp 61-67) **H^- source developments.** Allison, P.W. (Los Alamos Scientific Lab., NM). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

The design and operation of a Penning discharge, cold cathode, surface plasma H^- ion source are described. A high current density, about 2 A/cm², is extracted from the source by putting about 20 keV across the 2 to 2½ mm gap. (PMA)

50934 (LA—7265C, pp 68-70) **Chalk River experience.** Schriber, S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1978.

From Space charge in linear accelerators workshop; Los Alamos, NM, USA (31 Oct 1977).

In Space charge in linear accelerators workshop.

A brief description is given of research efforts at Chalk River to develop ion sources. The work includes duoplasmatrons, duopigatrons, bending magnet systems, and plasma oscillations. (PMA)

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 51510

50935 (LA—7001-M) **Introduction to Q.** Kellogg, M.; Minor, M.M.; Shlaer, S.; Spencer, N.; Thomas, R.F. Jr.; van der Beken, H. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1978. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

This manual presents an overview of the Q data-acquisition system. Its purposes are to assist an experimenter in determining whether the system is suited to his needs and to provide an introduction to the more detailed manuals. This system employs a powerful technique for dealing with multiprocessor systems by generating code and communication protocol for two processors from a single source program in a high-level language. Some details of experimental event buffering and distribution are discussed.

50936 (LA—7299-M) **Microprocessor-controlled CAMAC data link module.** Potter, J.M. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 40p. Dep. NTIS, PC A03/MF A01.

Communication between the central control computer and remote, satellite data-acquisition/control stations at the Clinton P. Anderson Meson Physics Facility (LAMPF) is presently accomplished through the use of CAMAC-based Data Link modules. With the advent of the microprocessor, a new philosophy for digital data communications has evolved. Data Link modules containing microprocessor controllers provide link management and communication network protocol through algorithms executed in the Data Link microprocessor. 13 figures.

STORAGE RINGS

REFER ALSO TO CITATION(S) 50949

50937 (BNL—24291) **Beam separation for p-anti p collisions in a single ring in the multibunch mode.** Berley, D.; Garren, A.A.; Month, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 5p. (CONF-780345—1). Dep. NTIS, PC A02/MF A01.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

A discussion is given of proton-antiproton colliding beam operation in storage rings. Some means of separating the beams at points where no experiment is being performed seems to be an important feature for a p-anti p colliding beam ring. By exciting a betatron oscillation in some appropriate, localized region, one could create a specific collision point while at the same time cause the p and anti p beams to oscillate in opposition so that their orbits meet at only a small number of points, roughly given by twice the tune, 2ν.

50938 (COO—2232A-58) **System of cylindrical drift chambers in a superconducting solenoid.** Camilleri, L.; Blumenfeld, B.J.; Dimcovski, Z. (European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., New York (USA); Oxford Univ. (UK); Rockefeller Univ., New York (USA)). 1978. Contract EY-76-C-02-2232. 20p. (CONF-780235—3). Dep. NTIS, PC A02/MF A01.

From Wire chamber conference; Vienna, Austria (14 Feb 1978).

A superconducting solenoid at the CERN ISR was equipped with a system of high accuracy cylindrical drift chambers. This detector consists of eight layers of field shaped drift cells with a delay line opposite each sense wire to provide coupled two dimensional readout. The design, construction, and operation of this system are discussed. The resolution and performance of the delay lines and sense wires under ISR running conditions are shown.

INSTRUMENTATION

50939 **High-level noise source for the calibration of Johnson noise power thermometers.** Blalock, T.V.; Borkowski, C.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Rev. Sci. Instrum.;* **49**: No. 8, 1046-1053(Aug 1978).

A new high-level noise source was developed specifically for the calibration of Johnson noise power thermometers (JNPT), but it is useful in other applications requiring a stable, wideband, well-defined noise power spectral density. The design concept for the noise source is based on the fact that the open-circuit thermal noise voltage of a feedback resistor, connecting the output to the input of an inverting amplifier, is available at the amplifier output from an equivalent low output impedance caused by the feedback mechanism. The noise power spectral density level at the noise source output is equivalent to the density of the open-circuit thermal noise of a 100-Ω resistor at a temperature of about 64 000 K. The noise source has an output power spectral density that is flat to within 0.1% (0.0043 dB) in the frequency range 1—150 kHz which brackets typical passbands of the signal-processing channels of JNPTs. The noise source was evaluated by comparing its output noise power with the thermal noise power generated by a platinum resistor of known ohmic value at the temperature of the aluminum freezing point (933.52 K). The measured noise power was within 0.06% of the value computed from the fundamental thermal noise equation of Nyquist. The power spectral density varies less than 0.03% for ambient temperature fluctuations in the range 15°—35°C.

50940 **Multichannel scaling with an eight bit microcomputer.** Fultz, B.; Morris, J.W. Jr. (Department of Materials Science and Mineral Engineering and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of Californa, Berkeley, California 94720). *Rev. Sci. Instrum.;* **49**: No. 8, 1216(Aug 1978).

In this note a microcomputer-based system for multichannel scaling is described. This system relies on a combination of simple hardware with software support to achieve maximum cost effectiveness.

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 50113, 51005, 51251

50941 (CONF-780110—12) **On-line monitor for the detection of aerosols containing uranium and the transuranics.** Yule, T.J. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From 11. symposium on radiation instrumentation; San Diego, CA, USA (17 Jan 1978).

An extremely sensitive on-line monitor for alpha-emitting aerosols containing uranium and the transuranics has been developed. If the only alpha activity present were that associated with the decay of these aerosols, then monitoring for significant concentrations would be straightforward. There is, however, a naturally occurring source of alpha activity from the decay of radon and thoron daughter products. These background levels may be several orders of magnitude greater than the maximum permissible airborne concentration, MPC/sub a/, of the aerosol that is being monitored. The monitor that is described here incorporates discrimination against background activity that is based on two factors. Firstly, the background activity is associated with small-sized dust particles, while the aerosol to be monitored has most of its activity associated with large-sized particles. Secondly, the alpha energies from the two sources are different. The monitor utilizes virtual impactors to concentrate the large-sized particles into a flow that is a small fraction of the intake flow. The flow containing the large particles is then passed through a filter to collect the particles. The filter is viewed by a solid-state detector for alpha spectroscopy. The monitor is capable of detecting less than one MPC/sub a/ of soluble aerosols containing plutonium, 0.002 pCi/l, in less than one-half hour.

50942 (LBL—7206) **One-dimensional curved wire chamber for powder x-ray crystallography.** Ortendahl, D.; Perez-Mendez, V.; Stoker, J.; Beyermann, W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1978. Contract W-7405-ENG-48. 16p. (CONF-780235—2). Dep. NTIS, PC A02/MF A01.

From Wire chamber conference; Vienna, Austria (14 Feb 1978).

A xenon filled single anode wire chamber with delay line readout has been constructed for use in powder x-ray crystallography using 8 to 20 keV x-rays. The entire chamber including the anode wire and the delay line which forms part of the cathode plane

is a section of a circular arc whose center is the powder specimen. The anode wire--38 μm gold-plated tungsten--is suspended in a circular arc by the interaction of a current flowing through it and magnetic field provided by two permanent magnets, above and below the wire, extending along the active length of the chamber. When filled with xenon to 3 atmospheres the chamber has uniform sensitivity in excess of 80% at 8 keV and a spatial resolution better than 0.3 mm.

50943 One-atom detection in individual ionization tracks. Kramer, S.D.; Bemis, C.E. Jr.; Young, J.P.; Hurst, G.S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Opt. Lett.;* 3: No. 1, 16-18(Jul 1978).

A major advance in one-atom detection using laser photoionization makes it possible to detect with microsecond time resolution single neutral atoms resulting from the stopping of energetic heavy ions in a buffer gas. This detection at the one-atom level, which gives the first direct evidence of nearly complete charge neutralization of stopped energetic ions, is shown to be possible even under the extremely adverse conditons associated with a densely ionized particle track.

RADIATION DOSEMETERS

50944 (PNL—2489) **Hanford environmental CaF_2:Mn thermoluminescent dosimeter.** Fix, J.J.; Miller, M.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1978. Contract EY-76-C-06-1830. 20p. Dep. NTIS, PC A02/MF A01.

The TLD-400 chips combined with the Pb-Ta field capsule provide a sensitive method of measuring penetrating ambient radiation in the environment. The method is best used for field deployments of about 1 month or less to minimize problems associated with fading. A correction factor of about 10% is necessary for the readings obtained for a 28-day field deployment and a 1-day wait before readout. Integration of reader output from 150°C to 280°C provides a good signal-to-noise ratio for TLD-400 chips exposed to 5 mR for the reader and planchet described herein. Visual inspection of the glow curves is recommended during startup of any new program or following any major instrument repair. The glow curves can be easily drawn with an X-Y recorder. Because of the large energy dependence of bare TLD-400 chips, an energy-flattening filter is necessary to allow a direct conversion from a reference exposure to observed field exposures. The field capsule used, consisting of 10 mil of tantalum and 2 mil of lead, provides an approximate uniform energy response above 70 keV. Below 70 keV, the response decreases rapidly because of the shielding. Experiments conducted have not shown the TLD-400 chips to be sensitive to the extremes of summer temperature (approximately 50°C) occasionally encountered at Hanford. Although the field dosimeter exhibits a directional dependence, this is of primary concern during calibration, in which the axis of the dosimeter should be normal to the photon beam. The procedures used to interpret the TLD chip reader output in terms of dose are fully described in the text.

50945 (UCID—17788) **Shonka chamber calibrations procedure.** Elliott, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 May 1978. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

The operational procedure for using Shonka type air-ionization chambers for calibrating radiation fields at the Lawrence Livermore Laboratory Hazards Control Dosimetry Calibrations Laboratory is described. The Shonka chambers described are air ionization chambers made of air-equivalent plastic spherical outer walls and center air-equivalent plastic collecting electrodes. When an electric field is applied, the current produced determines the rate of ionization within the chamber. A vent hole in each chamber allows equalization of pressure resulting in an output that is dependent upon temperature and pressure. Correction factors must be applied. An integrating electrometer determines the current.

50946 (UCRL—52415) **Neutron spectrum measurements for radiation protection purposes.** Slaughter, D.R.; Rueppel, D.W.; Fuess, D.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Feb 1978. Contract W-7405-ENG-48. 148p. Dep. NTIS, PC A07/MF A01.

The energy spectra of low-intensity neutron sources used for calibrating personnel neutron dose-rate meters and dosimeters and for characterizing the neutron fields to which personnel are exposed were measured. Several detector-analyzer systems that will measure in the energy range 50 keV to 20 MeV at intensities from 10^{-1} to 10^{5} n/cm²-s are described. The systems include NE213 and stilbene organic scintillators as well as H_2, ^3He, and CH_4 proportional counters. Also described are pulse-height analysis and pulse-shape discrimination systems. An unfolding code, NUTSPEC, reduces the pulse-height data to an absolute differential neutron flux phi(E) for the above detectors. The code uses a derivative unfolding method for the scintillation detectors, and for the proportional counters it calculates a response matrix and uses an iterative unfolding method to determine phi(E). The unfolded flux distribution combined with published conversion factors produces differential neutron dose-equivalent and kerma rates. Spectral segments obtained with different detectors from several measurements merge into a single differential flux spectrum over the range 50 keV to 20 MeV, together with the corresponding differential kerma and neutron dose-equivalent distributions. Also reported are spectrum measurements near ^{252}Cf and $^{238}PuBe$ sources with various moderators.

50947 Changes in dose rate along the radiation beam axis of x-ray units. Leshchinskii, N.I.; Nikulin, Yu.P. (Inst. of General Genetics, Moscow). *Radiobiology (USSR) (Engl. Transl.);* 17: No. 6, 160-162(1977).

Translated from Radiobiologiya; 17: No. 6, 934-935(1977).

In this work, determination was made of the adjustment factors that must be used for calculated dose rates in the case of unfiltered radiation. To investigate dose rate as function of distance to anode, in the case of unfiltered radiation from RUP-200 (RUM-11) and RUP-150/300 x-ray units, we first equalized the dose rate field at a distance of 600 mm from the tube anode. Measurement of dose rates was made using a chamber, 5.5 mm in diameter, of the VAI-18 dosimeter. This chamber has no range with hardness at the radiation energy used (about 30 keV). It can be approximately considered that, at distances to the anode of under 200 to 250 mm, an adjustment of 0.07/0.09% should be made for every millimeter of distance toward the anode, starting at 200 to 250 mm. The dose rate calculated according to the squares of distances should be increased by the obtained percentage. A maximum increase in dose rate of unfiltered radiation from the above-mentioned units (15/20%) is observed deep in the shielded housing window. In order to determine the radiation dosage, one must also take into consideration the attenuation of radiation in the irradiated object, nonuniformity in the direction perpendicular to the radiation beam axis and scatter of radiation.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 50946, 51081

50948 (EML—332) **New developments in field gamma-ray spectrometry.** Gogolak, C.V.; Miller, K.M. (Department of Energy, New York (USA). Environmental Measurements Lab.). Dec 1977. 46p. Dep. NTIS, PC A03/MF A01.

Specific gamma-ray spectrometric procedures have been developed for counting samples in the field. The analysis of spectra has been streamlined by the use of an on-line portable programmable calculator, making real-time interactive data analysis possible for both Ge(Li) and NaI(Tl) spectra. The results of a calibration of a 130 cm³ closed-end coaxial Ge(Li) detector are given for sources distributed in a soil-half space and in various sample geometries.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 50926, 50938

50949 (SLAC-Trans—184) **Picosecond time-of-flight spectrometer for the VEPP-2M based on local-discharge spark counter.** Pestov, Yu.N.; Fedotovich, G.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Jun 1978. Translation of IYaF—77-78, 1977. 19p. Dep. NTIS, PC A02/MF A01.

This time of flight spectrometer based on two localized-discharge spark counters operating on line with a computer is described. The resolution time of the spark counter itself is sigma = 30 psec. The spectrometer also utilizes six scintillation counters to reject the background and allow additional determination of particle type. The spectrometer is designed for the measurement of the form factor of π mesons in the 360 to 800 MeV energy range on the VEPP-2M, with differentiation of e, μ and π events on the basis of time of flight.

RADIOMETRIC INSTRUMENTS

REFER ALSO TO CITATION(S) 49530

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

50950 (UCRL—52454) **Transient electromagnetic measurements of a brass ship model.** Deadrick, F.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Apr 1978. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

The use of direct time domain, transient electromagnetic measurement techniques to characterize the electromagnetic cou-

pling properties of two high-frequency shipboard antennas is described. Experimental results were obtained for the RSNF/PGG-1 brass ship model (1/48/sup th/ scale) located over a perfect ground plane. The time domain measurement techniques are described, and the data obtained are presented. Examples of the potential use of time space domain measurements in Navy type problems are given including EMP coupling estimates.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 49364, 50124, 50752, 51193, 51526

50951 (UCRL—52420) **Capabilities for measuring physiocochemical properties at high pressure.** Heard, H.C.; Duba, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Feb 1978. Contract W-7405-ENG-48. 46p. Dep. NTIS, PC A03/MF A01.

A group of high-pressure systems that measure physicochemical properties of various media up to 2000°C and 30 GPa is described. With these systems it is possible to determine complete stress-strain behavior, ultrasonic velocities, permeability, phase studies, fracture-flow behavior, and optical and electrical properties. The apparatus is described in terms of published results, photographs, and schematic diagrams. 63 references.

50952 (UCRL—80924) **Framing-camera tube development for the sub-100-ps range.** Kalibjian, R.; Coleman, L.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 May 1978. Contract W-7405-ENG-48. 6p. (CONF-780804—1). Dep. NTIS, PC A02/MF A01.

From 13. congress on high-speed photography and photonics; Tokyo, Japan (20 Aug 1978).

A new framing-camera tube is capable of recording two-dimensional image frames with high spatial resolution in the sub-100-ps range. Framing is performed by streaking a two-dimensional electron image across narrow slits; the resulting electron line images from the slits are restored into a framed image by a restorer deflector operating synchronously with the dissector deflector. Performance has been demonstrated in a prototype tube by recording 125-ps-duration framed images of 2.5-mm patterns. The limitation in the framing speed is in the external electronic drivers for the deflectors and not in the tube design characteristics. Shorter frame durations (below 100 ps) can be obtained by use of faster deflection drivers.

50953 **Optical probe for local void fraction and interface velocity measurements.** Abuaf, N.; Jones, O.C. Jr.; Zimmer, G.A. (Brookhaven National Laboratory, Department of Nuclear Energy, Experimental Modeling Group, Upton, New York 11973). *Rev. Sci. Instrum.;* **49**: No. 8, 1090-1094(Aug 1978).

In view of the importance of obtaining unsteady local void fraction and interface velocities in liquid—vapor two-phase flows, an optical probe with a controlled tip geometry was developed and is described. In order to minimize the disturbances caused to the flow field by the presence of the probe, its dimensions have been miniaturized. The electronic and hydrodynamic responses of the probe were investigated experimentally. The probe was found to be sensitive to both the interface velocities and the phase present at the probe tip. A possible explanation for the behavior of the probe is presented. Within the velocity range checked and with proper calibration, the optical probe described can be used to determine both local void fractions and interface velocities.

50954 **Vapor concentration monitor.** Bayly, J.G.; Booth, R.J. (to Atomic Energy of Canada Ltd.). US Patent 4,033,699. 5 Jul 1977. Priority date 1 Aug 1974, Canada. 6p.

An apparatus is described for monitoring the concentration of a vapor, such as heavy water, having at least one narrow bandwidth in its absorption spectrum, in a sample gas such as air. The air is drawn into a chamber in which the vapor content is measured by means of its radiation absorption spectrum. High sensitivity is obtained by modulating the wavelength at a relatively high frequency without changing its optical path, while high stability against zero drift is obtained by the low frequency interchange of the sample gas to be monitored and of a reference sample. The variable HDO background due to natural humidity is automatically corrected.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 49449, 49531, 51324

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 50964, 50968

50955 (LA-UR—78-913) **Numerical modeling of the deflagration-to-detonation transition.** Mader, C.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 21p. (CONF-780806—1). Dep. NTIS, PC A02/MF A01.

From 17. symposium on combustion; Leeds, UK (20 Aug 1978).

The effect of a confined porous bed of burning explosive in contact with a solid explosive is studied by computer simulation. The burning is modeled using a bulk burn model that is a function of the surface area and the pressure. Once pressure excursions occur from the confined burning the transition to detonation is modeled using a pressure-dependent heterogeneous explosive shock decomposition model called Forest Fire. The occurrence of detonation in the solid explosive is shown to be dependent upon the surface-to-volume ratio, the confinement of the porous bed, and the geometry of the system.

50956 (LA-UR—78-1298) **Ignition and deflagration of potassium picrate (KP) and KP/explosives mixtures: low-voltage, nonprimary detonators.** Dinegar, R.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 17p. (CONF-780706—2). Dep. NTIS, PC A02/MF A01.

From 6. pyrotechnics seminar; Estes Park, CO, USA (17 Jul 1978).

Potassium picrate (KP) has been examined as a material which can be easily ignited to deflagration by a hot wire for application in low-voltage detonators which contain no primary explosives. KP can be ignited by a 0.05-mm-dia Nichrome wire at the 1-A/1-W level. KP mechanically blended with PETN or HMX in 10/90% by mass mixtures exhibit similar hot-wire ignition behavior to pure KP. These deflagrating mixtures generate higher pressures than pure KP and are therefore more useful as donor charges for accelerating an impact plate onto an acceptor charge or for driving a stress wave into a deflagration-to-detonation transition charge. Ignition and deflagration of KP and KP/explosives mixtures have been studied in terms of their dependence on explosive, electrical, and configuration parameters. These results are applied to the development of detonators of two types, flying plate detonators and deflagration-to-detonation transition detonators.

50957 (MHSMP—78-1) **TATB: water amination process.** Quinlin, W.T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Dec 1977. Contract EY-76-C-04-0487. 7p. Dep. NTIS, PC A02/MF A01.

A pilot-plant scale process for animation of sym-trichlorotrinitrobenzene (TCTNB) in the presence of water to produce sym-triaminotrinitrobenzene (TATB) has been developed. With this process the chlorine content from trapped impurities is reduced from the typical 0.5 to 1.0 percent range fown to about 0.1 percent. This reduction in chlorine is accompanied by a decrease in size of the median particle by 5 to 10 μm.

50958 (SAND—78-0203C) **Development of a small, safe pyrotechnic valve actuator.** Steele, B.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 19p. (CONF-780706—6). Dep. NTIS, PC A02/MF A01.

From 6. pyrotechnics seminar; Estes Park, CO, USA (17 Jul 1978).

Development of a Pyrotechnic Valve Actuator with several new design concepts has recently been completed. This actuator offers advantages in size, electrostatic safety, high "g" load capability, severe temperature extremes, bonfire safety, and advanced testing techniques.

50959 (UCID—17836) **Isostatic pressing of TATB and RX-03-AU to specified densities.** Hallam, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1978. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

Pressure-density relationships have been established for isostaticly pressing TATB and RX-03-AU (TATB/Kel-F 95/5). These relationships are useful for choosing the correct pressure for pressing billets to a desired density. The data were obtained from Site 300 isostatic pressing records and represent attempts to produce billets of specified densities that were required for machining into test specimens. No pressings were made for the sole purpose of studying pressure-density relationships. TATB must be pressed at 100°C or above to avoid cracked billets. Part of the observed variations in low density TATB pressings is caused by differnces in the particle size distributions. Three high pressure cycles are necessary to achieve

maximum density; with this technique, the particle size distribution is not a significant variable. A pressure-density curve for hot pressing RX-03-AU was established between pressures of 500 and 30,000 psi.

50960 (UCRL—52460) **Variations in the detonation velocity of the high explosive LX-04-1.** Scribner, K.J.; Zaslawsky, E.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Apr 1978. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

The purpose of this study was to give, with some statistical confidence, the maximal likely variation in detonation velocity in a pressed part made of the plastic-bonded explosive LX-04-1. Direct velocity-measurement techniques are not sensitive enough to resolve the small variations involved; however, the detonation velocity of any PBX is known to be a function of its composition and its density, which can be measured with sufficient precision. Therefore, the approach taken here was a statistical analysis of composition and density variations, from which the detonation-velocity variations could be inferred. The data base comprised compositional analyses of all lots of LX-04-1 used in W62 and W70 production, and density measurements obtained in destructive analysis of an approximately 2% sample of all of the W62 and W70 LX-04-1 parts. By control-chart theory, it was determined that the maximal probable variation in detonation velocity in any pressed part of LX-04-1 would be 0.0510 mm/μs. Such a variation in a 3-cm-thick part would result in a spread in breakout time of only 21 ns, which is small enough to permit taking advantage of the most sophisticated lighting systems.

50961 **Remote welding technique for high explosives containers.** Hildner, R.A. (Los Alamos Scientific Lab., NM). *J. Hazard. Mater.;* **2**: No. 2, 183-187(Jun 1978).

Samples of high explosives for environmental testing have been successfully enclosed in all-welded assemblies. Proper container design, fixturing, welding power supply, and welding parameters ensure the safe, timely completion of the task.

50962 (DOE-tr—76) **Thermostable explosives and their effects in deep boreholes.** Baum, F.A.; Derzhavets, A.S.; Sanasaryan, N.S.; Shipitsin, L.A.; Duvanov, A.M.; Grigoryan, N.G.; Chikhladze, N.S. May 1978. Translation of Termostoykie Vzryvchatye veshchestva i ikh deystvie v glubokikh Skvazhinakh, Izdatel'stvo Nedra, Moscow, 1969. 176p. Dep. NTIS, PC A09/MF A01.

The specific conditions for conducting explosive shooting operations in deep boreholes under high hydrostatic pressure and high temperatures led to the development and investigation of new thermostable explosives and products made from them. The effects of increased pressures and temperatures on the thermostability of explosives and their susceptibility to the detonation impulse, as well as on their detonative capability, the powder combustion processes, and the effect of the explosion were studied. During the investigation of the thermostability of explosives, parameters of thermal ignition were determined under different conditions and basic regularities of the thermal explosion of a number of thermostable explosives were defined. Under conditions of increased hydrostatic pressures, the addition of additives to the explosives proved to be quite effective in preventing deterioration of the explosive. Research in the field of exciting explosive detonations with shock waves is reported. Other interesting and new features discussed are the theoretical and experimental investigations that were conducted to study the effect of increased hydrostatic and rock pressures on the effect of an explosion (in particular, on the parameters of the underwater detonation of explosive charges), on pipe deformation processes during the underground detonation of explosives in order to form a cavity, and on the penetration of the cumulative jet into liquids, metals, and rock. On the basis of thermostable powders, compositions were developed for propelling the striker and the pellets in deep boreholes, and their ballistic characteristics at increased temperatures and pressures were investigated in detail. 104 references. (JGB)

50963 (UCRL-Trans—11315) **Millimeter-wave measurements of the transmission and reflection of detonation plasmas produced by solid explosives.** vom Stein, H.D.; Koch, B. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). Dec 1977. Translation of Technical Note ISL-T-3/68, 7 Feb 1968. 20p. Dep. NTIS, PC A02/MF A01.

Transmission and reflection coefficients of detonation plasmas produced by solid explosives are measured by means of millimeter waves and used to calculate their conductivity and relative permittivity. Because of the limited spatial resolution corresponding to the utilized wavelength of 8.6 mm, no quantitative statement can be made concerning the conductivity profile of the actual detonation front. The method provides only mean values over distances of a few millimeters inside the cloud of gas and smoke following the front.

NUCLEAR

REFER ALSO TO CITATION(S) 51009

CIVIL USES

50964 (UCRL—52457(Rev.1)) **Selected surface-motion measurements from high-explosive cratering experiments at Big Black Test Site in Mississippi during 1976—1977.** Rohrer, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jun 1978. Contract W-7405-ENG-48. 72p. Dep. NTIS, PC A04/MF A01.

Peaceful nuclear explosives have been suggested for use in various excavation projects. A proposed treaty would limit the total possible yield for a single-charge and row configurations. In 1976 and 1977, Lawrence Livermore Laboratory conducted a series of single- and row-charge cratering experiments for possible application in various excavation projects. The report describes a selected number of those experiments, giving the onset of first motion, peak spall velocity, onset of gas acceleration, and velocity at the end of gas acceleration for the center target of each single-charge experiment and for every target in the row-charge experiments. Graphs illustrate the unsmoothed displacement of each target as a function of time. For each single-charge experiment, peak velocities are compared to crater dimensions and the charge depth that produced the highest velocity and largest crater dimension is identified. Peak velocities from the row-charge experiments are also related to charge depth and spacing to determine an optimum depth for the single charges as well as the optimum depth and spacing for the row charges that produced the highest surface velocities.

50965 (LA-tr—78-46) **Question of industrial nuclear explosions.** (CEA, 75 - Paris (France). Direction des Applications Militaires). 1978. Translated from Commissariat a l'Energie Atomique, Direction des Applications Militaires, No. 62, pp 5-7 (Jan 1978). 8p. Dep. NTIS, PC A02/MF A01.

The capacity of France, the United States, and the Soviet Union to participate in industrial operations using nuclear explosions is assessed. Possible future uses are explored. (TFD)

50966 **Economic considerations for recovering copper from deep sulfide deposits by nuclear rubblization.** Petrovic, L.J. (Resource Engineering Inc., Burlington, MA); Hard, R.A.; Klumpar, I.V. *In Situ;* **1**: No. 3, 235-248(1977).

Copper recovery using nuclear rubblization in-situ leaching was studied to estimate the economic feasibility and to identify problem areas for future research and development. A plan for commercializing this chemical mining process was built around a detonation schedule of 10 chimneys every 3 years, a leaching cycle of six years, and an annual copper production of 40,000 tons (metric). The results show that recovery using this method is profitable for a type of deposit that would be unprofitable by any conventional method. Commercialization of this technology depends primarily on the public's resistance to this type of activity.

WEAPONRY

50967 (SAND—77-1435) **Surface motion near underground nuclear explosions in desert alluvium Operation Nougat I, Area 3, Nevada Test Site.** Perret, W.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1978. Contract EY-76-C-04-0789. 115p. Dep. NTIS, PC A06/MF A01.

During Operation Nougat I, which was conducted in late 1961 and the first half of 1962, Sandia Laboratories measured surface motion in the vicinity of all contained underground nuclear explosions conducted by the Los Alamos Scientific Laboratory in Area 3 of the Nevada Test Site. This report presents and analyses most of the data derived from that study. Propagation velocities in the desert alluvium, 4440 ft/sec, and underlying tuff, 6020 ft/sec, are typical of those derived from later measurements. Motion attenuation data exhibit considerable scatter, in part because of early measurement and data reduction techniques but primarily because of differences in the characteristics of the geologic media which had not then been recognized. However, regression fits to the scaled data show attenuation of scaled acceleration at a rate 35% greater than that observed for Merlin event data (Merlin was conducted later in Area 3). The attenuation rate for particle velocity data from Nougat I events was 47% less than that for Merlin data, and the Nougat I scaled displacement data attenuation rate was 87% less than that for Merlin data. Analysis of data from a vertical string of gages extending to the surface above the Mink explosion has established a significant difference between normal spallation above contained explosions in competent rock and the reaction of uncemented alluvium to similar explosive loading.

50968 **Scientific data base management, time series analysis, and data display.** Malthan, J.A. (Agbabian Associates, El Segundo, CA); Burgess, D.N. pp 200-206 of Environmental technology '76. Pro-

ceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Since the concluding of treaties banning testing of nuclear devices in the atmosphere, data necessary to continued development of nuclear weapons have in some cases been obtained in field tests in which high-yield chemical explosives were used in lieu of nuclear devices. In 1972 it was decided that a central file of raw data from such tests was necessary. The steps involved in assembling, organizing, and maintaining these data are described under the headings data archive, data directories, data identification system, data management system, and data processing. An example case to illustrate the four types of processing requests was shown. Types of data display are summarized. 7 figures, 4 tables. (RWR)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

50969 **How big can waves get.** *Ocean Ind.;* **13**: No. 6, 40-41(Jun 1978).

Careful study of meteorological conditions and sea states by Joseph Goldman has led to models of giant waves (up to 219 ft) that can be expected in storms in several areas of the world (Gulf of Alaska, Atlantic Ocean near Iceland, North Sea, etc.).

BASIC STUDIES

REFER ALSO TO CITATION(S) 50428

50970 (CONF-770478—P1, pp 427-428) **Application of synthetic aperture radar (SAR) to remote sensing.** Kozma, A.; Larson, R.W. (Environmental Research Inst. of Michigan, Ann Arbor). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

50971 **Simultaneous measurements of turbulence in the lower atmosphere using sodar and aircraft.** Thomson, D.W.; Coulter, R.L.; Warhaft, Z. (Department of Meteorology, The Pennsylvania State University, University Park 16802). *J. Appl. Meteorol.;* **17**: No. 6, 723-734(Jun 1978).

Simultaneous measurements of C/sub T/^{2} and C/sub v/^{2} were made using a calibrated Doppler sodar and a research aircraft equipped with meteorological and turbulence sensors. In each experiment a region of specific interest was identified using the sodar and then the aircraft vectored into it using air-ground radio. Measurements were made in both "layers" (with and without detectable turbulence and "waves") and in convective plumes. In each case the spectra of turbulent temperature and velocity fluctuations derived from the in situ observations showed a well-developed inertial subrange. Excellent agreement was found between the magnitude of the in situ aircraft C/sub T/^{2} and C/sub v/^{2} values and those derived from the sodar signals interpreted using the Tatarski scattering theory.Examples are shown of how sodar may be used for real-time, quantitative estimates of the dissipation rate of turbulent kinetic energy ϵ, and the rate of destruction of temperature variance N. On the present Penn State sodar system the operator may select a display of C/sub T/^{2}, C/sub v/^{2}, ϵ, N or winds derived from signal Doppler shifts. Either time series at selected heights, vertical times sections on a color, digital video display, or conventional printed or graphical output may be produced.

50972 **Variations in measured values of lateral diffusion parameters.** Doran, J.C.; Horst, T.W.; Nickola, P.W. (Atmospheric Sciences Department, Battelle, Pacific Northwest Laboratories, Richland, Wash. 99352). *J. Appl. Meteorol.;* **17**: No. 6, 825-831(Jun 1978).

The behavior of the quantity S=σ/sub y//xσ/sub theta/ for surface releases of tracers is examined. Variations in this quantity for different field programs are shown to be attributable largely to variations in sampling time tau and averaging time t; larger values of S are found to be associated with longer tau and t. Other previously disregarded quantities, viz., mean wind speed and atmospheric stability, are shown to have potentially important effects. Two spectral models are presented which reproduce many of the observed features.

50973 **Climatic change: volcanoes, man-made pollution, and carbon dioxide.** Dittberner, G.J. (Univ. of Wisconsin, Madison). *IEEE Trans. Geosci. Electron.;* **GE-16**: No. 1, 50-61(Jan 1978).

The causes of climatic change are summarized with emphasis on what appear to be the three most important factors external to atmospheric processes controlling climate on the scale of decades. These are (1) high level stratospheric particles injected by volcanic eruptions, (2) the increase in carbon dioxide due to an increase in industrial activity, and (3) generation of lower atmospheric particles directly caused by man. A historical perspective on each of these begins with the earliest discoveries and ends with current state of the art knowledge. The impact of these factors on climate is examined using the model of Bryson and Dittberner. Results show that these three factors can indeed simulate, remarkably well, the past behavior of hemispheric climate as best we know it. The most important implication to emerge from this study is that climate is affected not only by nature, but also by man through the burning of fossil fuels and the subsequent production of carbon dioxide and particulates.

50974 **Generalization of the Kolmogorov—von Karman relationship and some further implications on the values of the constants.** Frenzen, P. (Argonne National Lab., IL). *Boundary-Layer Meteorol.;* **11**: 375-380(1977).

A general relation between the Kolmogorov (α_1) and von Karman (k) constants appropriate to flows in the surface boundary layer is obtained by including stability- and divergence-dependent terms in the development. The result is used to show that the author's earlier inference of the value k = 0.36 drawn from the observed value α_1k/sup $^4/_3$/ = 0.141 cannot have been underestimated due to the neglect of stability or divergence effects. It is concluded that, if k is to be > or = 0.4, then α_1 must be < or = 0.5. 1 figure.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 49418, 49524, 49973, 50745, 51015, 51016, 51125, 51260, 51262, 51263, 51295, 51296

50975 (ANL—76-88(Pt.3)) **Radiological and Environmental Research Division annual report: Ecology, January—December 1976.** (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-ENG-38. 131p. Dep. NTIS, PC A07/MF A01.

Separate abstracts were prepared for 29 sections of this report. A list is included of 41 publications during the period covered.

50976 (BNL—24023) **Processes limiting the oxidation of sulfur dioxide in stack plumes. II.** Schwartz, S.E.; Newman, L. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 42p. Dep. NTIS, PC A03/MF A01.

A formalism is developed for treating chemical reactions in stack plumes whose constituents are being diluted as the reaction proceeds, in order to examine the dependence of the ultimate extent of reaction upon the interplay between dilution and chemical reaction. This treatment is developed first for plumes of uniform cross-section and is then extended to plumes of arbitrary cross-section. It is shown that the rate of plume expansion exerts a controlling influence upon reactions that are higher than first-order in plume constituents, and that chemical reactions are quenched at high expansion rates. The conditions that lead to quenching depend only upon the order of reaction and the rate of expansion and are independent of the details of the reaction mechanism. For the concentration of a conservative tracer diminishing with time proportionately to t$^-$/sup n/, a p-th order reaction is quenched for n(p-1) >1 and unquenched for n(p-1) < or = 1. The meteorological stability classes that would lead to quenching of second- and third-order reactions are considered. The formalism that is developed is applied to a re-examination of SO_2 oxidation data obtained in studies of the Northport, N.Y. oil-fired and Sudbury, Ontario nickel-smelter plumes to ascertain the extent to which observed decreases in reaction rates may be ascribed either to dilution or to depletion of a catalyst or other reactive species that is co-emitted and co-diluted with SO_2. This re-examination confirms that the mechanism of oxidation was higher than first order in plume constituents and strongly suggests second order. The data are consistent with the second-order mechanism for a wide range of assumed catalyst/SO_2 ratio. It is thus established that no inference may be drawn from such data concerning catalyst depletion as a mechanism for limiting the in-plume reaction.

50977 (EPA—450/3-78-019) **Priorities for new source performance standards under the Clean Air Act amendments of 1977.** Monarch, M.R.; Cirillo, R.R.; Cho, B.H.; Concaildi, G.A.; Smith, A.E.; Levine, E.P.; Brubaker, K.L. (Argonne National Lab., Ill. (USA)). Apr 1978. Contract W-31-109-ENG-38. 250p. Dep. NTIS, MF A01.

Portions of document are illegible.

The Clean Air Act (CAA) as amended provides the fundamental enabling legislation for controlling air pollution in the U.S. It provides a number of different mechanisms by which the federal government can regulate the emissions of air pollutants. One of the more important mechanisms is commonly referred to as New Source Performance Standards (NSPS). It is the purpose of this work to develop and apply a systematic methodology for choosing the source categories that should be considered first for in-depth analysis prior to NSP promulgation. The objective of this exercise is to conduct a preliminary, but comprehensive, screening of source categories to select those of most concern in developing NSPS and to present decision-makers with sufficient technical information upon which to make informed policy choices as to where limited resources are best spent. Those source categories for which an NSPS has already been proposed or promulgated have been excluded from consideration. This reduces the number of sources to be considered somewhat but still leaves the number in excess of 200 categories. The pollutants considered here include the criteria pollutants (particulates, sulfur dioxide, nitrogen oxides, hydrocarbons, carbon monoxides), lead, sulfuric acid mist, hydrogen sulfide, and fluorides. The first five have had a National Ambient Air Quality Standard (NAAQS) promulgated for them. Lead has a NAAQS proposed. The others are designated pollutants and have had NSPS set for some sources.

50978 (UCRL—52432) **Livermore Regional Air Quality (LIRAQ) application to St. Louis, Missouri.** Duewer, W.H.; Walton, J.J.; Grant, K.E.; Walker, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1978. 84p. Dep. NTIS, PC A05/MF A01.

In this interim report, we describe the methods developed to convert data from the Regional Air Pollution/Regional Air Monitoring Study (RAPS/RAMS) into a format compatible with the Livermore Regional Air Quality (LIRAQ) models. We also describe the changes made in the LIRAQ models that: improve map plotting routines, update the chemical mechanism, and incorporate a partial SO_2 oxidation mechanism. We describe work carried out for the U.S. Environmental Protection Agency. This work is incomplete largely because emissions data needed to run the model have not yet been provided.

50979 (Y/UB—8) **United States Department of Energy, Oak Ridge Facilities. Environmental monitoring report, calendar year 1977.** (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 21 Jun 1978. Contract W-7405-ENG-26. 70p. Dep. NTIS, PC A04/MF A01.

The DOE Oak Ridge Reservation contains three major operating facilities: the Oak Ridge National Laboratory (ORNL), the Oak Ridge Gaseous Diffusion Plant (ORGDP), and the Y-12 Plant; all of which are operated by Union Carbide Corporation, Nuclear Division. In addition, two smaller DOE facilities are in the area: the Comparative Animal Research Laboratory, and the Oak Ridge Associated Universities. The Environmental Monitoring Program for the Oak Ridge area includes sampling and analysis of air, water from surface streams, creek sediments, biota, and soil for both radioactive and nonradioactive materials. This report presents a summary of the results of the program for calendar year 1977. Surveillance of radioactivity in the Oak Ridge environs indicates that atmospheric concentrations of radioactivity were not significantly different from other areas in East Tennessee. Concentrations of radioactivity in the Clinch River and in fish collected from the river were less than 6 percent of the permissible concentration and intake guides for individuals in the offsite environment. The total body dose to a hypothetical maximum exposed individual at the site boundary was calculated to be 7.2 mrem/yr. Surveillance of nonradioactive materials in the Oak Ridge environs shows that established limits were not exceeded for those materials possibly present in the air as a result of plant operations, with the exception of fluorides which exceeded the limits on several occasions. Several abatement projects to reduce fluoride emissions became fully operational in 1977. The chemical water quality data in surface streams obtained from the water sampling program indicated that average concentrations resulting from plant effluents were in compliance with State stream guidelines with the exception of fluorides which were slightly over the limit.

50980 Development and use of an easily transportable filter device for particulate air pollutant measurements. Bake, D.; Laskus, L. (Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene). *Staub-Reinhalt. Luft;* **38**: No. 1, 21-24(Jan 1978). (In German).

A small filter device for the determination of particulate air pollutants is described which may be used for indoor and outdoor studies. On account of its simple design ensuring safe operation, low noise during operation, its low weight, and also low cost the device may be operated without difficulty. Operation including exchange of filters has been designed so as to enable easy handling also in the field and by unskilled persons. Performance parameters and the respective values are given. A report is presented on the operation of ten sets developed by the authors over a period of three months.

50981 Spatial and temporal distribution of nitrogen oxides in urban air. Lahmann, E.; Prescher, K.E. (Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene). *Gesund.-Ing.;* **99**: No. 1/2, 32-36(Jan 1978). (In German).

The significance of nitrogen oxides with a view to air pollution does not only originate from direct hazardous effects, but also from participation in photochemical reactions in the atmosphere which can lead to further harmful substances. Investigations of emissions to be expected have revealed a marked increase in nitrogen oxides, e.g. for the territory of the EC from 1970 to 1985 an annual increase from 7.6 to 13 million tons. There is comparitively (as against sulfur dioxide and carbon monoxide) little information available on amounts and distribution of nitrogen oxides in the atmospheric air of German towns.

50982 Evaluation of the GCA respirable dust monitor 101-1. Marple, V.A.; Rubow, K.L. (Univ. of Minnesota, Minneapolis). *Am. Ind. Hyg. Assoc. J.;* **39**: No. 1, 17-25(Jan 1978).

The GCA Respirable Dust Monitor Model 101-1 has been evaluated using aerosols of coal, Arizona road dust, silica, potash, and rock (copper ore) particles. The effects of the dust mass concentration, particle size distribution, and dust material on the instrument response were investigated. The instrument was found to measure the mass concentrations of respirable dust aerosols up to about 16 mg/m^3 for coal and rock dust and about 20 mg/m^3 for silica, potash, and Arizona road dust, providing there is not appreciable mass in the size range below approximately 0.7 μm aerodynamic diameter.

50983 Expediency of determining cumulative emission. Bernert, J. *Wasser, Luft Betr.;* **21**: No. 12, 646-648(Dec 1977). (In German).

A new VDI Guideline will be appearing in the near future on the determination of basic nitrogen compounds that can be absorbed in sulphuric acid. With it, another recommendation, i.e. for the determination of cumulative emission, will come into force and acquire significance. This article deals with the expedience of these measuring methods in the light of practical examples.

50984 Source functions of CO_2 and future CO_2 burden in the atmosphere. Zimen, K.E.; Offermann, P.; Hartmann, G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). *Z. Naturforsch., a;* **32**: No. 12, 1544-1554(Dec 1977).

A logistic source function for CO_2 was derived which takes into account the input arising from the burning of fossil fuels, the stimulation of photosynthesis by the increasing partial pressure of CO_2 and the decrease of biomass through deforestation etc. The parameters in a 5-box-model for the kinetics of CO_2 were adjusted to fit the new Mauna Loa data on CO_2 concentrations in air. Using these parameters and a buffer factor for the apsorption of CO_2 into the sea, the future CO_2 burden was calculated for status quo conditions and for different values of the growth coefficient of fossil fuel consumption. The results show that one can change the deforestation factor in rather wide limits without changing very much the future CO_2 concentration in air during the next 80 years or so. On the other hand, the future CO_2 burden depends strongly on the growth rate of fossil fuel consumption and will double under status quo conditions early in the next century.

50985 Chlorofluorohydrocarbons - environmental risk. Schurath, U. *Chem. Unserer Zeit;* **11**: No. 6, 181-189(Dec 1977). (In German).

Whether chlorofluoroydrocarbons, used especially as sponging agent in spray cans, are decomposing the ozone layer of the atmosphere so that harmful solar radiation would get through to the earth's surface and, amongst others, could lead to increased skin cancer, has been discussed for years. The problem of what science today can definitely say on the possible environmental risk is discussed in detail.

50986 Mercury emissions from chlorine-production solid waste deposits. Lindberg, S.E.; Turner, R.R. (Oak Ridge National Lab., TN). *Nature (London);* **268**: No. 5616, 133-136(14 Jul 1977).

A study was made of the mercury emissions from wastes stored near an inactive chlorine plant; during 1952 to 1972 it produced chlorine and caustic soda using the Hg-cell process. Air, water, and waste samples were collected during 1974 to 1976. The total annual flux of Hg from this inactive plant is estimated to be 75 +- 5 kg/year, approximately 6% of the EPA standard for Hg emission to air and water from active chlorine plants in riverine environments. (DLC)

50987 Ozone und Begleitsubstanzen in photochemischem Smog. (Ozone and related substances in photochemical smog). Duesseldorf, Germany, F.R.; VDI-Verl. (1977). 218p. (In German). (AED-Conf—76-440-000).

From Colloquium on ozone and related substances in photochemical smog; Duesseldorf, Germany, F.R. (22 - 24 Sep 1976).

The increasing number of cases of photochemical oxidant air pollution in the FRG as well as in the other european countries induced the VDI-Kommission Reinhaltung der Luft, to call together experts at home and abroad in order to report on and discuss air chemistry, analytics, and measuring results of these gaseous substances of the atmosphere on the one hand, and their effects on man, animals, plants, and material goods on the other. Noteworthy high concentrations of photooxidants in the sunny summer of 1976 emphasized the topical character of the subject chosen. Lectures and discussion contributions gave an excellent survey of existing knowledge and informed of possible prevention measures concerning this air pollution which often exceeds the limits.

50988 Global influences of the aerosol and CO_2 contents of the air on the climate. Mueller, W.A. pp 79-96 of Chemische und physikalische Umweltbelastungen. Tagung ueber Umweltforschung der Universitaet Hohenheim. Kunick, W.; Kutscher, G. (eds.). Stuttgart, Germany, F.R.; Univ. Hohenheim (1977). (In German)

Worldwide no impacts on account of the anthropogenic effects of increasing aerosol particles and CO_2 contents, which exceed natural deviations, can be detected at the moment. In the future it will depend on the superposed increase (or decrease) rate of aerosol and CO_2, whether there will be an increase or decrease in temperature. The extent of an aerosol particle and CO_2 increase by realistic amounts on the basis of model calculations made so far seems to be small, however there ought to be clearly visible effects, e.g. as they start to appear in town climates, and here in particular in connection with the radiation household.

50989 Air cleaning in mineral oil industry and petrochemistry. Weber, R. (Deutsche Shell A.G., Hamburg (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 83-93(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Intensified environmental conservation noticeable since about 1960 has increasingly led to more stringent regulations being made by the authorities for the mineral oil industry and the operators of petrochemical plants, often without scientific justification. Frequently measures demanded as a precaution referred to expectable emissions about whose extent, quality, as well as spread and fate in the atmosphere little was known. On behalf of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V. and in cooperation with it the following projects in connection with these problems have already been finished or are being carried out at the moment: 1) Investigation of leakage rates of sealing elements which resulted in a considerable adjustment by the authorities of factors used so far, as well as the results of an 2) investigation of emissions involved with storage, handling and transport of motor gasolines, 3) 'systems analysis' of methods for desulphurizing fuel oil and flue gases. Furthermore the following measures have been initiated: 4) Investigation of the processes of combustion on a high flare, 5) cooperation in drawing up a measurement system for monitoring area emissions from refineries and petrochemical plants, 6) ascertainment of unpleasant emissions from refineries within the range of analytical limits of detection, 7) clarification of the amount, fate or decomposition of biogenous and artificial hydrocarbons in the atmosphere.

50990 Air sampling methods for s-tetrachloroethane and other related chlorinated hydrocarbons. Yasuda, S.K.; Loughran, E.D. (Los Alamos Scientific Lab., NM). *J. Chromatogr.;* **137**: 283-292(1977).

An acid-treated Pittsburgh Activated Carbon (PAC) tube for sampling s-tetrachloroethane in air is described that minimizes sample losses through dehydrogenation and dehydrohalogenation reactions. Commercially prepared NIOSH charcoal, untreated PAC, and acid-treated PAC tubes are compared as to their effectiveness in stabilizing s-tetrachloroethane. Common homologues and analogues of s-tetrachloroethane cause no interference with the gas chromatographic method. In addition the effectiveness of the untreated PAC and acid-treated PAC tubes was also evaluated for four different chlorinated aliphatic hydrocarbons. 2 figures, 5 tables.

50991 International agreement needed to reduce long-range transport of air pollutants in Europe. Ottar, B. (Norsk Institutt for Luftforskning, Lillestroem). *Ambio;* **6**: No. 5, 262-269(1977).

In Europe large amounts of air pollutants are transferred to areas more than 1000 km from major source regions. The main cause of the acidification of the precipitation is the sulfur content of fossil fuel. Several countries in northwestern Europe receive as much air pollution from outside as from indigenous sources. An international agreement to reduce the emissions is required in order to reduce substantially the sulfur pollution.

50992 Comprehensive model for the prediction of air quality adjacent to urban expressways. Chen, T.C.; Olender, W.K.; Michalove, R.A. pp 418-423 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

The problem of predicting air quality adjacent to urban expressways is one of great concern to environmentalists, highway designers, urban planners, and public agencies involved in the preparation and evaluation of environmental impact statements. A new comprehensive urban highway diffusion model termed CUES (Concentrations at Urban Expressway Sites) was developed and successfully used to predict air quality in New York City. Unlike previous line source models, CUES is applicable to complex roadway configurations (combinations of at-grade, elevated and depressed elements) subject to arbitrary changes in alignment and extreme traffic loading. The model combines an analytical finite line source representation of roadway elements with statistical parameters obtained from a comparison of theoretical and measured concentrations. This approach results in a calibrated model capable of predicting future inert pollutant levels within an appropriately chosen statistical confidence interval for specific traffic, meteorology highway configuration, and year of operation.

50993 Statistical comparison of two street canyon models for predicting urban traffic related air quality. Angiola, A.J.; Chen, T.C. (Parsons, Brinckerhoff, Quade and Douglas, Inc., New York). pp 424-429 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

A statistical comparison was made of two street canyon air quality models. The two models are the SRI model and the crude Box model. Although the SRI model is more sophisticated, calibrated results were not significantly better than results for the Box model.

50994 Environmental studies for the West Side Highway Project. Rosen, S.S. (Parsons, Brinckerhoff, Quade and Douglas, Inc., New York). pp 430-435 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

This paper describes the environmental impact studies performed as part of the West Side Highway Project in New York City. Specifically, the paper will discuss the water, noise, and air quality studies, three of the studies relating to the impact of this transportation project on the physical environment.

50995 Air quality considerations in site qualification studies for a fossil-fueled electric generating plant. Roffman, A. (Westinghouse Environmental Systems Dept., Pittsburgh). pp 456-464 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

In the course of selecting a site suitable for a fossil-fuel steam electric power generating plant, a number of potential sites are considered. It is important, when searching for a proper site, to evaluate the relative merit of each site by taking into account all the important factors involved. Thus, the possibility of site rejection based on inappropriate evaluation is reduced significantly. One of the major environmental considerations associated with the selection procedure is the air quality issue. Generally, only a conceptual design of the facility is available at the time the site selection study is conducted. The air quality study, while primarily aimed at the site qualification analysis, can prompt possible changes or modifications in the conceptual design features and therefore, lead to a better balanced site selection study that accounts for both environmental and economical considerations. Environmental considerations include: compliance with applicable ambient air quality and emission standards, possible impact on the biota and esthetics. Economic considerations include: the number of stacks and their height, fuel characteristics and the degree of emission reduction.

50996 Defining the relationship between annual emission reduction and air quality improvement to determine the impact of a citywide air pollution control program. Fisher, F. pp 465-470 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Linear regression equations of annual air quality on cumulative emission reduction which resulted from implementation of agency strategies, by pollutant, were used to determine the relation-

ship between changes in air quality and emission reduction over a five year period. An independent confirmation of this relationship is obtained when the ratio of cumulative tons per year reduced to the decrease in emission inventory is compared to the coefficient of determination. This is necessary because relating emissions and air quality through regression analysis alone would not confirm that there is a causal relationship. To shed further light on the relationship between emissions and air quality, the improvement in the emission inventory is compared to the change in air quality during the five year period. Considering the many variables involved, a strong relationship is indicated.

50997 Suspended particulates and mortality costs: a preliminary investigation for United States metropolitan areas. Liu, B.C.; Yu, E.S.H. (Midwest Research Inst., Kansas City, MO). pp 471-479 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Three objectives achieved include: a nonlinear dose-response function relating residual mortality rates to the concentration level of suspended particulates was developed and estimated; utilizing the dose-response function and a permanent income formulation, total and per capita economic damages attributable to suspended particulates for 40 SMSA's were computed; and an average economic damage function relating mortality damages to a host of socioeconomic, demographic, climatological, and suspended particulates variables was constructed, and empirical results were derived. Total damages due to TSP were estimated at $1,044 million for the 40 SMSA's. It is found that mortality costs on the average may be reduced by 4.9% or $75.6 million if the TSP level can be lowered by 10.0%. The damage estimates were derived by making a number of simplifying assumptions.

50998 Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975). 334p. (CONF-7405125—).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

Environmental monitoring of toxic substances from industry and agriculture is producing a growing volume of data on harmful materials in the terrestrial and aquatic milieu. Before we can assess the biological effects of toxic substances, scientists must learn the basic chemistry of pollutants, the mechanisms by which they enter and move through organisms, their concomitant transformations, the nature of toxic reactions within tissues, and the way in which life on earth is affected. The specialists who contributed the vast amount of useful information contained in this volume critically evaluate present knowledge and identify those areas of research in which accelerated progress seems particularly necessary. Among the vital topics examined in this volume are: ecotoxicology—a survey of a new science; heavy metals and organohalogens in aquatic and terrestrial ecosystems; heavy metal and organohalogen accumulation and excretion in organisms; effects of pollutants in land and sea organisms; and polychlorinated biphenyl compounds and other potentially presistent industrial chemicals. Separate entries were made for the individual items.

50999 Ecotoxicology: a new branch of toxicology: a general survey of its aims, methods, and prospects. Truhaut, R. (Universite Rene Descartes, Paris). pp 3-23 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

Pollutants in the physical environment are discussed with regard to principal sources, entry into the environment, distribution, and fate. The fate of pollutants in living organisms and ecosystems is discussed with regard to metabolic changes and reactions with chemical constituents of organisms. Harmful effects of chemical pollutants on constituents are discussed with regard to the various forms of toxicity; the influence of various factors on manifestation of toxicity; and the importance of establishing dose-response relationships. Perspectives and prospects in ecotoxicology are also discussed. (HLW)

51000 Entry, distribution, and fate of heavy metals and organohalogens in the physical environment. pp 233-256 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

Trace metals and halogenated hydrocarbons in the atmosphere are discussed with regard to sources, entry, distribution, fate, and recommendations. Trace metals and halogenated hydrocarbons in the soil are discussed with regard to sources, entry from air, entry from wastes, entry from direct application, entry from water, distribution, fate, and recommendations. Trace metals and halogenated hydrocarbons in water are discussed with regard to sources, entry, distribution, fate, particulate transport, chemical transformations, short- and long-term sinks for sediment and pollutants in lake and harbor beds, interactions in estuaries, mass balance studies, dynamics at the estuary-sea interface, and predictive models. A summary of research recommendations is presented with regard to mass balances of pollutants, distribution by particle size, transformations while resident in the system, setting of uniform criteria, alternatives to use of manufactured chemicals, and model formulation. (HLW)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 50257, 50941, 50954, 50979, 51017, 51025, 51243, 51257

51001 (EML—342) **Environmental Measurements Laboratory environmental quarterly, March 1, 1978—June 1, 1978.** Hardy, E.P. Jr. (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Jul 1978. 283p. Dep. NTIS, PC A13/MF A01.

This report presents current information on plutonium isotopes in stratospheric air, plutonium and other alpha emitters in marine organisms, radionuclides in seaweed following the Chinese nuclear test of March 15, 1978, plutonium from Rocky Flats in lake sediment, strontium-90 in diet, benzo(a)pyrene measurements in western lake sediment, radionuclide and lead concentrations in surface air, and Sr-90 in deposition, milk, diet, and tap water. A bibliography of recent publications related to environmental studies is also presented.

51002 (EML—342(App.)) **Appendix to Environmental Measurements Laboratory environmental quarterly.** Hardy, E.P. Jr. (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Jul 1978. 209p. Dep. NTIS, PC A10/MF A01.

Tabulated data are presented on fallout ^{90}Sr deposition at various world land sites during 1976 and 1977; the content of ^{7}Be, ^{95}Zr, ^{137}Cs, ^{144}Ce, ^{90}Sr, and Pu isotopes in samples of surface air collected at various world land sites; the content of ^{90}Sr in relation to Ca in samples of milk collected in New York City; and the content of ^{90}Sr and ^{137}Cs in New York City tap water.

51003 (NVO—178) **Transuranics in natural environments.** White, M.G.; Dunaway, P.B. (eds.). (Energy Research and Development Administration, Las Vegas, Nev. (USA). Nevada Operations Office). Jun 1977. 720p. (CONF-761065—). Dep. NTIS, PC A99/MF A01.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

Separate abstracts were prepared for the 35 papers presented at the conference. (HLW)

51004 (NVO—178, pp 249-271) **Measurements of americium and plutonium in the atmosphere.** Efurd, D.W.; Merrill, G.L. Jr.; Phelps, J.T.; Rosenlof, K.D. (McClellan Central Lab., McClellan AFB, CA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Alpha spectrometry and high sensitivity mass spectrometry have provided complementary data which have proven useful in understanding fluctuations in the atmosphere, particularly the relationship between plutonium activity levels and variations in the $^{240}Pu/^{239}Pu$ isotope ratios. A summary of past plutonium data plus some recent measurements are presented. Previously unpublished ^{241}Am data collected from 1963-1970 are also presented. These data indicate that the $^{241}Am/^{239}Pu$ atom ratio in the atmosphere has been decreasing since 1967. Explanations for this anomaly are postulated.

51005 (NVO—178, pp 273-286) **Development of specialized instruments and techniques for resuspension studies.** Phelps, P.L.; Anspaugh, L.R. (Lawrence Livermore Lab., CA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

An intensive study on the resuspension of plutonium at the Nevada Test Site has been initiated. The main thrust of the study is to develop a mathematical model for describing the concentrations of plutonium in air as a function of the source and driving forces. It is intended that the model be a basis for assessing potential health hazards and developing cleanup recommendations. In addition, the study is providing an opportunity to develop a generalized resuspension model, applicable in general for establishing environmental and

biological assessment of nuclear projects involving plutonium. Apparatus and experimental techniques for studying the dynamics of plutonium and soil particle behavior have been developed. This has included the development of ultrahigh-volume air samples (1500 m^3/hr) which allow collection of adequate samples of plutonium at worldwide air concentration levels in two hours of sampling time. We have also developed samplers for measuring the fraction of particles moving in creep and saltation. The Air Resources Laboratory, National Oceanic and Atmospheric Administration, has established an elaborate meteorological data-gathering system for measuring micrometeorological parameters, during sampling periods at the Nevada Test Site. Advanced optical methods for in situ sizing and counting particles have also been employed. This technique allows observations of particle size and concentration of a few-minute time scale, such that rapid changes in meteorological parameters may be more directly correlated with the concentration of airborne particles and their size distributions.

51006 (NVO—178, pp 303-320) **Foliar and root pathways of plutonium contamination of vegetation.** Dahlman, R.C. (Oak Ridge National Lab., TN); McLeod, K.W. Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Plutonium enters the terrestrial environment from testing of nuclear weapons and from nuclear technologies. Assimilation of Pu by vegetation depends on source term characteristics and mode of exposure to different Pu sources in the environment. For Pu released to the atmosphere from nuclear facilities, direct deposition of airborne particles on foliage accounts for most of the incipient contamination of vegetation. Assimilation of Pu via the roots generally yields Pu concentrations in edible tissues that are lower by at least an order of magnitude; however, lifetime exposure of humans will depend increasingly on the entry of Pu into foods by the root pathway. These concepts are confirmed from information obtained from contaminated environments at Savannah River and Oak Ridge. Radiologic doses calculated for ingestion of Pu-contaminated vegetables show that direct deposition of airborne Pu on surfaces yields doses that are a factor of ten higher than those for Pu assimilated into the plants by roots.

51007 (NVO—178, pp 593-600) **Some new statistical concepts for quality control.** Kinnison, R.R.; Jarvis, A.N. (Environmental Monitoring and Support Lab., Las Vegas, NV). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

A statistical technique is presented whereby radioisotope quality control can be substantially improved. The basis of this technique is an examination of the statistical distribution of the data.

51008 (NVO—178, pp 601-619) **Ratio estimation techniques in the analysis of environmental transuranic data.** Doctor, P.G.; Gilbert, R.O. (Battelle Pacific Northwest Labs., Richland, WA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Ratios play a prominent role in the analysis of environmental transuranic data. The mathematical assumptions underlying the use of ratios are presented. The properties of seven different estimators of an average ratio and their standard errors are discussed with respect to their applicability to transuranic field studies. The behavior of these estimators, their standard errors, and confidence intervals are compared for three representative sets of data from safety-shot sites at the Nevada Test Site and Tonapah Test Range. Guidelines are given for deciding if an average ratio is appropriate. Recommendations for avoiding an inappropriate estimator are discussed.

51009 (SAND—78-0133C) **Aerosols generated by ^{239}PU and ^{233}U droplets burning in air.** Nelson, L.S.; Raabe, O.G. (Sandia Labs., Albuquerque, N.Mex. (USA); Lovelace Foundation for Medical Education and Research, Albuquerque, N.Mex. (USA). Inhalation Toxicology Research Inst.). 1978. Contract EY-76-C-04-0789. 5p. (CONF-780622—10). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

The inhalation hazards of radioactive aerosols produced by the explosive disruption and subsequent combustion of metallic plutonium in air are not adequately understood. Results of a study to determine whether uranium can be substituted for plutonium in such a situation in which experiments were performed under identical conditions with laser-ignited, single, freely falling droplets of ^{239}Pu and ^{233}U are reported. The total amounts of aerosol produced were studied quantitatively as a function of time during the combustion. Also, particle size distributions of selected aerosols were studied with aerodynamic particle separation techniques. Results showed that the ultimate quantity of aerosols, their final particle size distributions, and depositions as a function of time are not identical mainly because of the different vapor pressures of the metals, and the unlike degrees of violence of the explosions of the droplets.

51010 (UCRL—52365) **Calculational examination of the Baneberry event.** Terhune, R.W.; Glenn, H.D.; Burton, D.E.; McKague, H.L.; Rambo, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Dec 1977. Contract W-7405-ENG-48. 72p. Dep. NTIS, PC A04/MF A01.

On December 18, 1970, Baneberry, a 10-kt nuclear device, was detonated at a depth of 278 m in hole U8d at the Nevada Test Site. A shock-induced fissure near ground zero opened and vented radioactive gases and debris into the atmosphere. This report presents the calculational results describing the sequence of dynamic phenomena that produced the vent. The calculations predict the long positive velocity pulse and the surface motion that were observed experimentally. The surface fissure through which the material vented is the same radial distance from ground zero as the maximum horizontal displacement is calculated to be. The calculations predict a final cavity radius that is very close to the measured Baneberry cavity radius. Finally, the calculations indicate that an open fracture path runs from the cavity to the Baneberry Fault, up the fault to the spall region, and then vertically to the surface. This was the vent path predicted by calculations and is consistent with the vent path found from the radioactivity in postshot drill holes. Because of our extensions in computational capabilities, we believe this report advances the state of the art for numerical simulation of the containment problems associated with underground nuclear tests.

REGULATIONS

REFER ALSO TO CITATION(S) 49522, 50425, 50429, 50983

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

51011 Mineral element composition of perennial vegetation in relation to soil types in the northeastern corner of the western desert of Egypt. El-Ghonemy, A.A. (Univ. of Tanta, Egypt); El-Gazzar, A.; Wallace, A.; Kishk, R.; Romney, E.M. *Bot. Gaz. (Chicago);* **138**: No. 2, 192-205(1977).

The northeastern corner of the western desert of Egypt is characterized by marked topographic, climatic, and soil variations, which have caused the formation of different habitat types with their own distinct vegetational structures. The magnitude of differences in edaphic factors among these habitat types has been demonstrated by ordering them along axes representing important soil variables. Some ecological attributes of perennial shrubs growing at each habitat type were determined by nondestructive and numerical measurements. The mineral element composition of these shrubs was determined by emission spectroscopy and was correlated with the prevailing environmental conditions.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 49430, 50979, 50998, 50999, 51000, 51125, 51260, 51295

51012 In situ degradation of oil in a soil of the boreal region of the Northwest Territories. Westlake, D.W.S.; Jobson, A.M.; Cook, F.D. (Univ. of Alberta, Edmonton, Can.). *Can. J. Microbiol.;* **24**: No. 3, 254-260(Mar 1978).

Replicate field plots comprising a control; control plus oil; control plus oil and fertilizer (urea phosphate, 27:27:0); control plus oil and bacteria; and control plus oil, fertilizer, and bacteria were established at Norman Wells, N.W.T., Canada. Plots were monitored over a 3-year period for changes in microbial numbers and the chemical composition of recovered oil. Where fertilizer was applied, there was a rapid increase in bacterial numbers, but no increase in fungal propagules. This was followed by a rapid disappearance of n-alkanes, isoprenoids, and a continuous loss in weight of saturate compounds in recovered oil. Changes in the content of asphaltenes, aromatics, and nitrogen-, sulphur-, and oxygen-containing fractions are also discussed. The seeding of oil-soaked plots with oil-degrading bacteria did not have any effect on the composition of recovered oil.

Fertilized plots showed a more rapid rate of vegetation with cotton grass and Labrador tea being the dominant species in revegetation.

51013 Cadmium, lead, and zinc distributions and cycling in a mixed deciduous forest. Van Hook, R.I.; Harris, W.F.; Henderson, G.S. (Oak Ridge National Lab., TN). *Ambio;* 6: No. 5, 281-286(1977).

Cadmium, lead, and zinc distributions and cycling were determined in a mixed deciduous forest in eastern Tennessee (USA). Major points of accumulation were litter and small roots, while soil was the long-term sink. Biogeochemical cycles of Cd, Pb, and Zn were conservative with respect to inputs (inputs much greater than losses) and total quantities in the system (losses much less than standing pools). Transport of Cd, Pb, and Zn through vegetation was rapid (turnover times averaging 3.3 years), but the slow response of soil and the potential for recycling from soil to vegetation acted to effectively retain these elements within the ecosystem.

51014 Some effects of pollutants in terrestrial ecosystems. Stickel, W.H. (Fish and Wildlife Service, Laurel, MD). pp 25-74 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

Some topics discussed are as follows: community structure and function; greater effect of pollution on carnivores than on herbivores; delayed mortality; mutagenesis; behavioral changes in birds and mammals; reproduction; stimulating effects of small doses; food chain concentrations; effects of pesticides on soil organisms and insects; sensitivity of amphibians and reptiles to insecticides; and sensitivity of birds and mammals to DDT, PCB, and other pesticides. (HLW)

51015 Species variation in the metabolism of some organic halogen compounds. Williams, R.T.; Hirom, P.C.; Renwick, A.G. (St. Mary's Hospital Medical School, London). pp 91-106 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

The following topics are discussed: types of halogenated compounds in the environment; metabolic reactions of chlorinated hydrocarbons; metabolism of chlorinated benzenes, naphthalenes, PCB, DDT, aldrin, dieldrin, chlorophenoxyacetic acids, and hexachlorocyclohexane; and excretion of organic chlorinated compounds in different species. (HLW)

51016 Potentially persistent industrial organic chemicals other than PCB. Zitko, V. (Fisheries Research Board of Canada, St. Andrews, New Brunswick). pp 197-206 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

The widespread contamination of the environment by polychlorinated biphenyls (PCB) demonstrated that persistent chemicals should not be incorporated into products with uncontrollable ultimate fate and that extreme care must be taken to minimize the discharge or leakage of such compounds into the environment. It is hoped that as a result of voluntary actions by industry, recommendations of international organizations, and regulatory actions, the use of PCB has been limited to essential applications. However, it is not known what compounds are used or planned to be used to replace PCB in the nonessential applications, and little is known about other potentially persistent industrial chemicals. This paper summarizes some information, based mainly on industrial and patent literature, on compounds and preparations which are likely to be used as PCB substitutes, and on some other industrial chemicals. The term "industrial chemicals" covers a wide variety of synthetic chemicals used as final products, additives, or intermediates, but excluding uses based on biological activity. Accordingly, polyethylene, dioctyl phthalate, and vinyl acetate are industrial chemicals, whereas pesticides used on the basis of their biological activity are not considered industrial chemicals in the present context.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 50749, 50948, 50979, 51003, 51005, 51006, 51007, 51008, 51010, 51243, 51256

51017 (ANL—76-88(Pt.3), pp 43-46) **Distribution of fallout and stack-derived plutonium in some midwestern soils.** Alberts, J.J.; Muller, R.N.; Sprugel, D.G.; Bobula, C.M. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Soil samples were taken at three locations: Mound State Park located directly east and at a distance of 100 yards from the boundary of the Mound Laboratory in Miamisburg, Ohio; the Library Park in Miamisburg, located one-half mile north of the Mound Laboratory; and a wooded area near Hueston Woods, approximately 25 miles west of Miamisburg. The Miamisburg sites were chosen because of the high concentration of ^{238}Pu that exists in soils near the Mound Laboratory. The Hueston Woods sample was chosen as representative of background concentrations derived from atmospheric levels of both ^{238}Pu and $^{239\ 240}$Pu. The $^{238\ 239\ 240}$Pu concentrations were higher in the surface soil for both the Miamisburg locations than in surface soil from Hueston Woods, indicating that $^{239\ 240}$Pu, as well as ^{238}Pu, had been added to the surrounding area from the Mound Laboratory stacks. The difference in concentrations of ^{238}Pu and $^{239\ 240}$Pu at the two sites in Miamisburg reflects the greater distance of Library Park from the stack.

51018 (NVO—178, pp 25-39) **Sampling of soils for transuranic nuclides: a review.** Fowler, E.B.; Essington, E.H. (Los Alamos Scientific Lab., NM). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

A review of the literature pertinent to the sampling of soils for radionuclides is presented; emphasis is placed on transuranic nuclides. Sampling of soils is discussed relative to systems of heterogeneous distributions and varied particle sizes encountered in certain environments. Sampling methods that have been used for two different sources of contamination, global fallout, and accidental or operational releases, are included.

51019 (NVO—178, pp 41-75) **Distribution of transuranic nuclides in soils: a review.** Essington, E.H.; Fowler, E.B. (Los Alamos Scientific Lab., NM). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

The literature is reviewed to ascertain the degree of movement and the distribution patterns for transuranic and uranium nuclides in soils. Typical plutonium and uranium profiles are presented and an attempt is made to identify unique characteristics causing deviation from an ideal distribution pattern. By far most of the distribution observations are with plutonium and little is reported for uranium and other transuranic nuclides.

51020 (NVO—178, pp 77-96) **Factors influencing the chemical extractability of ^{241}Am from a contaminated soil.** Nishita, H.; Hamilton, M. (Univ. of California, Los Angeles). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

Factors influencing the extractability of ^{241}Am from an artificially contaminated soil were investigated. This was done with an equilibrium batch technique using a CH_3COOH-NH_4OH and HNO_3-NaOH extracting system. The influence of several soil components was determined indirectly by selectively removing them from the soil. The effect of water- and HCl-soluble salts and organic matter on ^{241}Am extractability was small. The most marked effect was due to the soil organic fraction that was not water- or HCl-soluble. This organic fraction was influential under both low and high pH conditions, but its influence was particularly marked under low pH conditions. The free iron-oxides had an appreciable effect under low pH conditions, but no observable effect in the high pH range. Though to a lesser extent, the free silica and alumina, amorphous alumino-silicate, and possibly residual organic matter also showed some influence. These results provide some implications on the conditions that influence the movement of ^{241}Am in soils and its availability to plants. A review of the literature on the behavior of Am in soils is included.

51021 (NVO—178, pp 97-114) **Plutonium association in soils.** Tamura, T. (Oak Ridge National Lab., TN). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

This paper reviews the association of plutonium in the soils and sediments of several contaminated environmental samples. The plutonium-matrix association based on selected chemical treatments is reviewed. The association of plutonium with the soil particle sizes is reviewed and a soil plutonium index is derived for several contaminated sites to permit comparison of the potential transfer to man via the inhalation pathway. The soil plutonium index accounts for the fraction of the total activity in the resuspendible sizes, the

relative concentration of the activity on the soil particle, and the potential lung deposition upon inhalation. The derived soil plutonium indices for four sites range from 0.52 to 1.26 from the least to the most severely contaminated site. The order of increasing site severity is the Nevada Test Site (0.52), Oak Ridge National Laboratory (0.69), Mound Laboratory (1.18), and Rocky Flats (1.26). Limitations of the soil factor are discussed.

51022 (NVO—178, pp 115-126) **Distribution of plutonium and americium at a former Los Alamos waste disposal site.** Fried, S. (Argonne National Lab., IL); Friedman, A.M.; Hines, J.; Schmitz, G.; Wheeler, M. Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

A thirty year old liquid waste disposal site at Los Alamos Scientific Laboratory has been cored and a portion of each six inch increment analyzed for plutonium and americium. The site received unprocessed low level waste solutions from 1945 to 1952, and treated waste effluents from 1952 to 1967. The actinide content of each core increment was determined by low energy photon spectroscopy utilizing the characteristic L x-rays of each nuclide. The data obtained are presented as a histogram and compared to gross activity measurements made at the site. A laboratory simulation of the site was also prepared using simulated waste solutions and a specimen of disposal site's geologic material, tuff, a welded volcanic ash. This simulation was scaled and proportioned according to archival records of the original site. The results of this experiment are compared with measurements from the actual core sample.

51023 (NVO—178, pp 127-169) **Relationship of microbial processes to the fate of transuranic elements in soil.** Wildung, R.E.; Drucker, H.; Au, F.H.F. (Battelle Pacific Northwest Labs., Richland, WA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

This review considers the influence of soil physiochemical and microbial processes on the long-term solubility, form, and plant availability of plutonium and other transuranic elements important in the nuclear fuel cycle. Emphasis is placed on delineation of the relationships between soil chemical and microbial processes and the role of soil microorganisms in effecting solubilization and transformation of elements considered largely insoluble in soils strictly on the basis of their inorganic chemical characteristics. Soluble, diffusible Pu in soils (usually less than 0.1% of total) appears to be largely present as particulates of hydrated oxide, but several lines of evidence suggest that microorganisms may influence the solubility of Pu and that the nonparticulate plant-available fraction is stabilized in solution by inorganic or organic ligands of limited concentration in soil. The role of soil microorganisms in influencing the solubility, form and plant-availability of the transuranics is discussed on the basis of the known chemistry of organic ligands in soils, effects on the soil microflora, and principal microbial transformation mechanisms, including direct alteration (valence state, alkylation), indirect alteration (metabolite interactions, influence on the physiochemical environment), and cycling processes (biological uptake and release on decomposition of tissues). The toxicity of Pu to microorganisms depends on Pu solubility in soil. However, soil microorganisms are generally resistant to Pu, with toxicity apparently due to radiation rather than chemical effects. Highly resistant bacteria, fungi, and actinomycetes have been isolated from soil, and these organisms have been shown to be capable of transporting Pu into the cell and altering its form in the cell and in solution. The resulting soluble Pu complexes tend to be of higher molecular weight than simple complexes (Pu-DTPA) and negatively charged.

51024 (NVO—178, pp 171-179) **Estimation of aerosol plutonium transport by the dust-flux method: a perspective on application of detailed data.** Shinn, J.H. (Lawrence Livermore Lab., CA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Two methods of dust-flux measurements are discussed which have been utilized to estimate aerosol plutonium deposition and resuspension. In previous studies, the methods were found to be sufficiently detailed to permit parameterization of dust-flux to the erodibility of the soil, and a seventh-power dependency of dust-flux (or plutonium flux) to wind speed was observed in worst case conditions. The eddy-correlation method is technically more difficult, requires high-speed data acquisition, and requires an instrument response time better than one second, but the eddy-correlation method has been shown feasible with new fast-response sensors, and it is more useful in limited areas because it can be used as a probe. The flux-gradient method is limited by critical assumptions and is more bulky, but the method is more commonly used and accepted. The best approach is to use both methods simultaneously. It is suggested that several questions should be investigated by the methods, such as saltation stimulation of dust-flux, simultaneous suspension and deposition, foliar deposition and trapping, erodibility of crusted surfaces, and horizontally heterogeneous erodibility.

51025 (NVO—178, pp 181-210) **Plutonium and tracer particle resuspension: an overview of selected Battelle-Northwest experiments.** Sehmel, G.A. (Battelle Pacific Northwest Labs., Richland, WA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Plutonium resuspension at Rocky Flats was determined in July 1973, by measuring airborne plutonium as a function of sampling height and of wind speed. The maximum airborne plutonium-239 concentration was 3700 aCi/m^3. The maximum plutonium-239 activity per gram of collected airborne soil was 50 pCi/g. Airborne plutonium concentrations were shown to increase as the sixth power of wind speed, but the data were very imprecise. In measurement of fallout resuspension caused by burning vegetation, the ^{137}Cs concentration in a forest fire smoke plume was 22 times the concentration in ambient air. Resuspension rates for a man walking across a tracer area on an asphalt surface ranged from 1×10^{-5} to 7×10^{-4} fraction of tracer resuspended/pass. For vehicular traffic driven on a tracer lane, resuspension rates from the asphalt surface ranged from 10^{-4} to 10^{-2} fraction resuspended/pass. When the vehicle was driven on the lane adjacent to the tracer lane, resuspension rates were smaller, ranging from 10^{-5} to 10^{-3} fraction resuspended/pass. Resuspension rates decreased when the tracer had been on the ground for several days. In comparison to the asphalt surface, vehicle-caused tracer resuspension rates from a cheat grass area were lower, ranging from 10^{-5} to 10^{-4} fraction resuspended/pass. Wind caused tracer resuspension rates were on the order of 10^{-11} fraction resuspended/sec for nonrespirable particles. Resuspension rates for respirable particles increased as the 4.8th power of wind speed, ranging from 10^{-11} to 10^{-7} fraction resuspended/sec. In another study, airborne respirable soil concentrations measured as a function of wind speed increased as the 0.6 to 3.2 power of wind speed.

51026 (NVO—178, pp 211-222) **Review of resuspension models.** Healy, J.W. (Los Alamos Scientific Lab., NM). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Resuspension is classified, according to the prominent path of exposure and the type of consideration involved in estimating concentrations, as general resuspension, local resuspension, and transfer resuspension. General resuspension can be driven by winds or mechanical disturbances while local resuspension and transfer resuspension are primarily caused by mechanical disturbances. Modeling techniques consist of the resuspension factor, the resuspension rate and mass-loading. For general resuspension the resuspension rate is preferred while the resuspension factor or mass-loading approach can be used for local resuspension. Data for estimation of transfer resuspension are not really adequate to even make a first approximation as to its importance.

51027 (NVO—178, pp 233-247) **Brief survey of particle work relevant to the test sites.** Nathans, M.W.; Leventhal, L. (LFE Corp., Richmond, CA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

This paper presents an overview of the available data on the physical, chemical, and radiochemical properties of fallout particulates, of the methods by which both samples and data have been obtained and their limitations, and of the availability that remains mostly uncorrelated, but from which much information can be gleaned or inferred that is of interest to the NAEG program. Nevertheless, experimental characterization of particulates with special emphasis on transuranics is not only still possible but advisable.

51028 (NVO—178, pp 287-302) **Plutonium contamination of vegetation in dusty field environments.** Romney, E.M.; Wallace, A. (Univ. of California, Los Angeles). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Transport of plutonium in food chains of grazing animals and mankind by vegetation carriers becomes an important avenue of contamination in dusty field environments. Findings indicate that most of the activity present in vegetation of such areas at the Nevada Test Site (NTS) is superficial contamination resulting from the attachment of particles to foliage surfaces during resuspension. We suspect, however, that the root uptake pathway eventually will become more significant as the result of natural concentration and recycling processes at work in the field within the plant root zone.

51029 (NVO—178, pp 379-383) **Transuranic elements in terrestrial animals and the environment: an introduction.** Potter, G.D. (Environmental Protection Agency, Las Vegas, NV). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

This discussion provides background information to the session on the "Transuranic Elements in Terrestrial Animals." Briefly outlined are some of the historical events leading to the introduction and dispersion of the transuranic elements into the biosphere, to the establishment of the Nevada Applied Ecology Group (NAEG), and to the studies conducted by the Environmental Monitoring and Support Laboratory (EMSL-LV) and the University of Nevada-Las Vegas involving the transuranics distributed by the "safety shots" and the nuclear weapons testing program at the Nevada Test Site and the Tonopah Test Range. These studies are described in relation to the overall objectives of the NAEG program. Other potential sources of the transuranic radionuclides are also discussed.

51030 (NVO—178, pp 385-405) **Plutonium and other transuranics in small vertebrates: a review.** Bradley, W.G.; Moor, K.S.; Naegle, S.R. (Univ. of Nevada, Las Vegas). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

The published data relevant to transuranics in small vertebrates inhabiting terrestrial environments is reviewed. Experimental results indicate that atomic size and valence state affect rates of absorption, transportation, and excretion of transuranics in living systems. Whereas there is a marked tendency for transuranics to hydrolyze to insoluble colloidal products at physiological pH, complexing agents and chelation enhance solubility and transportability. The natural modes of uptake of transuranics by vertebrates include absorption from the gut, the intact or damaged skin, and inhalation. Absorption from the gut into the bloodstream is very low. Potential hazards may exist if complexing or chelating agents are present, if absorption is continuous, or if exposure involves young animals. The intact skin provides an effective barrier to absorption of transuranics. Relatively high levels of absorption may occur when transuranics are administered subcutaneously or intramuscularly, particularly with increased acidity and solubility of the compounds. Inhalation is probably the most hazardous natural route of uptake. Insoluble transuranic compounds are retained in the lung and soluble compounds are transported rapidly via the blood to bone, liver, and other organs. Deposition of plutonium in mammalian gonads resulting in a decrease in spermatogenesis, ovarian damage, and reduced fecundity is documented. The current knowledge of the behavior of transuranics in terrestrial environments is limited. Plutonium and americium uptake by small mammals has been documented. Plutonium body burdens were related to depressed leukocyte count on a statistical basis. Reduced rodent populations in areas of high plutonium concentrations illustrate the problems of evaluating uptake by mobile animals.

51031 (NVO—178, pp 407-417) **Review of grazing studies on plutonium-contaminated rangelands.** Smith, D.D. (Environmental Protection Agency, Las Vegas, NV). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Literature is cited that has provided data on tissue actinide concentrations in grazing animals when the actinide dosages resulted from artificial administration or from periodic exposure. Only one long-term study is known where a reproducing beef herd was restricted to a plutonium-contaminated environment. Highlights of this study that are reviewed and discussed include: relationship of ingesta concentrations to food habits; tissue concentration related to length of exposure and level of exposure; and the concentration range in various tissues. Emphasis is given to the gonadal concentration which is approximately 25 times that of muscle and blood. Future study plans are also discussed.

51032 (NVO—178, pp 435-448) **Transport of plutonium via food products of animal origin.** Sutton, W.W.; Mullen, A.A. (Environmental Protection Agency, Las Vegas, NV). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Various plutonium studies have been conducted using domestic animals in an attempt to determine what fraction of a quantified exposure would reach the edible animal products. Following either intravenous or oral plutonium doses to selected livestock species, milk, liver, eggs and skeletal muscle have been considered as critical deposition sites or materials almost irrespective of resulting nuclide concentrations. Milk and eggs received primary attention as their production represents an efficient way of converting dietary crude protein and energy into edible substances. Potential problems concerning the biological availability of plutonium from in vivo labeled food materials and the hazards associated with recycling carcass residues have been considered.

51033 (NVO—178, pp 575-591) **Some design aspects of transuranic field studies.** Gilbert, R.O.; Eberhardt, L.L. (Battelle Pacific Northwest Labs., Richland, WA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

In this paper, we discuss some design aspects of transuranic field studies. Some of the principal steps in the design of such studies are given and illustrated using examples. This is followed by a review of sampling designs that have been used at nuclear detonation and safety-shot sites on the Nevada Test Site and elsewhere for estimating spatial pattern and total amounts in soil. Some design aspects of ecosystem-type transuranic studies for estimating total amounts as well as movement of transuranics between ecosystem components are also discussed. Acceptance sampling using either attributes or measurements is considered as a possible approach for deciding whether to clean up a contaminated site. Three general guidelines for the design of efficient transuranic studies are presented.

51034 (UCRL—52409-1) **Enewetak Radioecology Research Program. I. Ecological studies on Engebi Island, 1975—1976.** Koranda, J.J.; Robison, W.; Thompson, S.E.; Stuart, M.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Feb 1978. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

As part of the Lawrence Livermore Laboratory Enewetak Radioecology Research Program, we studied radionuclide cycling from soil to plant to soil on Engebi Island at the Enewetak Atoll. Mature and dying leaves, young and old litter, humus, and soil beneath these organic strata were collected from 1975-76 at three Engebi sites. To study radionuclide depth distributions, five trenches of > 1 m were dug and sampled. From three representative sites, we found that ^{137}Cs rapidly cycles from the plant biomass through the litter and humus into the vegetation. Continuously deposited litter decomposes within 6 to 12 months, but the constituent radionuclides are released early during physical decomposition. Soil radionuclides generally occur in the upper 40 cm of the soil profile, strongly associated with the organic horizon. Radionuclides such as ^{60}Co, $^{152-155}Eu$, ^{207}Bi, and ^{241}Am are complexed in the finely divided organic matter or humus where ^{137}Cs and ^{40}K predominate. Our data suggest that there is a circulating pool of rapidly cycling ^{137}Cs in the Engebi ecosystem that may be entirely associated with the plant biomass and organic strata of the soil. Soilbound radionuclides below the humus are low in concentration and may not enter into this pool because they are below the vegetation root zone, where they may be leached by rainwater. This information is needed in making realistic long-term radionuclide dose assessments for the Enewetak peoples.

SOIL

REFER ALSO TO CITATION(S) 49701

51035 (IDO—12085) **Activation and fission products in the environment near the Idaho National Engineering Laboratory Radioactive Waste Management Complex.** Markham, O.D. (Department of Energy, Idaho Falls, Idaho (USA). Idaho Operations Office). Apr 1978. 21p. Dep. NTIS, PC A02/MF A01.

From 1952 through 1972, solid radioactive waste containing activation and fission radionuclides was interred and stored in the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory (INEL) Site. In order to help assess the environmental consequences of the Subsurface Disposal Area at the Radioactive Waste Management Complex, small mammals and soil samples were collected near the Subsurface Disposal Area in 1972 to 1973 and analyzed for activation and fission nuclides. Levels of radioactivity in the deer mice (Peromyscus maniculates) were for the most part below detectable limits except in samples collected on the perimeter of the Subsurface Disposal Area. Detectable fission and activation nuclides in the soil were primarily Cs-137, Co-60, Ce-144, Sb-125, Ru-106, and Sr-90. However, soil concentrations of these nuclides at the perimeter of the Subsurface Disposal Area were relatively low. For example, the maximum Cs-137 concentration was only 12 times average concentrations found in soils from background locations and average Cs-137 concentrations were only about three times average background concentrations at 350 m from the Subsurface Disposal Area. It is concluded that the storage of radioactive waste at the INEL Radioactive Waste Management Complex has had little effect on the concentrations of activation and fission products in the environment near the Subsurface Disposal Area.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 51001, 51002, 51035

51036 Investigations on the ecophysiology of Geleia nigricepts kahl (Ciliophora, Gymnostomata) inhabiting a sandy beach in Bermuda. Hartwig, E. (Zoologisches Museum der Universitaet, Hamburg); Gluth, G.; Wieser, W. *Oecologia (Berlin);* **31**: 159-175(1977).

The dominant ciliate species Geleia nigriceps inhabiting a sheltered beach in Bermuda was characterized by its horizontal and vertical distribution on the beach in correlation with sediment composition and grain size, temperature, pH, oxygen, redox potential, and water coverage, its tolerance of high and low temperature under normoxic and oligoxic conditions, and its tolerance of extreme pH-values.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 49433, 49435, 49522, 49523, 50438, 50447, 50995, 51086, 51313

51037 (CONF-770478—P2, pp 1241) **Experimental land systems mapping with digital LANDSAT images.** Robinove, C.J. (Geological Survey, Reston, VA). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51038 Federal Land Policy and Management Act of 1976. *Calif. Geol.;* **30**: No. 3, 63-64(Mar 1977).

The Public Law 94-579, also known as the BLM Organic Act will affect 40 million acres of California land and over 1 million unpatented mining claims in California. The California Desert Conservation Area and the extension of the King Range National Conservation area are discussed. (DLC)

REGULATIONS

REFER ALSO TO CITATION(S) 49522, 50425, 50429

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 50428, 50975

51039 (ANL—76-88(Pt.3), pp 14-16) **Fish impingement at Lake Michigan power plants.** Sharma, R.K.; Freeman, R.F.; Spigarelli, S.A. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

A study was initiated in 1974 to survey the magnitude and to evaluate the impact of fish impingement at 20 power plants on the Great Lakes. Data on impingement rates, site characteristics, intake designs and operational features have been collected and analyzed. Interpretive analyses of these data are in progress. The objectives of this study were: to summarize fish impingement data for Lake Michigan (16/20 plants surveyed are on Lake Michigan); to assess the significance of total and source-related mortalities on populations of forage and predator species; and to expand the assessment of power plant impingement to include all water intakes on Lake Michigan. Data are tabulated.

51040 (ANL—76-88(Pt.3), pp 17-19) **Impact of cooling systems on Lake Michigan fishes.** Spigarelli, S.A.; Romberg, G.P. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

A comparison of data on fish mortalities due to impingement at thermal power plant water intakes on Lake Michigan with available estimates of standing crop biomass, commercial and sport fishery catches, and estimated predation mortality is presented. The striking features of these data are the proportions of total mortality due to predation and the lack of accurate basic population statistics such as standing crop biomass and natural mortality for important forage and human food fishes in Lake Michigan. Although this preliminary assessment would indicate that power plant and total impingement losses constitute an insignificant fraction of total forage biomass, the potentially unstable forage-predator ratios and the apparent high degree of annual fluctuations (year-classes) in alewife, smelt, and perch indicate the need for a more detailed assessment of cooling-system related impact on selected populations.

51041 (ANL—76-88(Pt.3), pp 93-98) **Sedimentological and mineralogical characteristics of recent sediments at selected sites in the southern basin of Lake Michigan.** Tisue, G.T.; Merk, G. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

During the 1976 field season, sediment traps and current meters were set out in the southern basin of Lake Michigan to study the relationship between suspended material and currents. The gross mineralogical and chemical characteristics of the bottom sediments at the locations of these experiments were determined.

51042 (ANL—76-88(Pt.3), pp 99-102) **Settling behavior of lacustrine organic mineral aggregates.** Chase, R.R.P. (Univ. of Chicago); Tisue, G.T. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Organic mineral aggregates are a cohesive sediment type composed of an organic matrix sorbed onto mineral flocs. These aggregates often form the uppermost layer of the freshwater benthos, and are especially prevalent in relatively low energy environments. Typical aggregates range in size from a few to a few hundred micrometers and have a loosely articulated structure, often containing void spaces. This imparts to them a low bulk density for Lake Michigan aggregates. Aggregates are deformable and susceptible to disruption under high shear conditions. Despite their ubiquity, the hydrodynamic behavior of these particles has not been adequately characterized. The kinematics of lacustrine organic mineral aggregates were investigated by means of a unique laboratory apparatus described earlier. The results show striking departures from predictions of settling behavior based on classical theory.

51043 (ANL—76-88(Pt.3), pp 103-106) **Factors affecting the collection efficiency of sediment traps in Lake Michigan.** Wahlgren, M.A.; Nelson, D.M. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Three sets of experimental traps, which have been deployed for portions of two field years on Lake Michigan, provide useful data on the effect of design factors on the collection efficiency of traps in this environment. The data also suggest effects of seasonal limnological factors.

51044 (ANL—76-88(Pt.3), pp 107-110) **Lake Michigan sediment trap study: preliminary assessment of results.** Wahlgren, M.A.; Nelson, D.M. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

During 1975, a sediment trap and current meter array was maintained at ANL station 75-5 in Lake Michigan. Samples collected at monthly intervals from these traps provided data at two depths which indicated considerable resuspension of surface sediment flocs, but only under the physical conditions of a relatively near-shore, high-energy environment. In order to establish whether resuspension is a general, lakewide phenomenon, even in lower energy environments, and whether its rate is variable in different regions of the lake, arrays of sediment traps were installed during 1976 at 5 stations across the southern basin of Lake Michigan. At four of the stations a current meter was located 1.5 m off bottom. Preliminary results are discussed.

51045 (ANL—76-88(Pt.3), pp 111-114) **Near-bottom currents measured during the 1976 mid-lake dynamics experiment.** Saunders, K.D. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Sediment entrapment rates determined from traps placed on the same mooring lines as current meters in Lake Michigan were plotted versus average kinetic energy density during periods when both sediment entrapment rate and current data were available. There is an indication that the sediment entrapment rates may be directly proportional to the available kinetic energy of the currents, which would be suspected in situations involving resuspension of sediment by the currents. The average direction of water motion at one meter at the bottom indicates that resuspended sediment will be transported toward the west.

51046 Heavy metals in the burrowing bivalve Scrobigcularia plana from the Tamar estuary in relation to environmental levels. Bryan, G.W. (Marine Biological Association, Citadel Hill, Eng.); Uysal, H. *J. Mar. Biol. Assoc. U.K.;* **58**: No. 1, 89-108(1978).

Concentrations of ten metals (Ag, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn) have been measured in the whole soft parts and digestive gland of the burrowing bivalve Scrobicularia plana (da Costa) over its range of distribution in the Tamar estuary. Four metals (Cu, Fe, Mn, Zn) have been analyzed in the individual tissues including the

shell. As far as possible, concentrations in the animals have been related to those in the environment. Seasonal variation, level on the shore and size of animal have also been considered. Partitioning of metals between the digestive gland and remaining soft tissues suggests that uptake of Cd, Co, Cr, Ni, Pb, and Zn occurs mainly through ingestion of sediments. Generally, more than 75% of the metals was found in the digestive gland. This organ contributed less to the total amount of Cu and Ag(30 to 40%), Mn(51 to 80%) and Fe(3 to 20%). Lower values of Mn and Fe were found upstream where the availability of "soluble" metals to the animals was higher. Concentrations of Cd, Co, Cr, Ni, Pb and Zn in the whole soft parts increased markedly with size, whereas Fe remained relatively constant and levels of Ag, Cu and Mn decreased. In the shell, most of the Mn was incorporated in the matrix, presumably via the mantle, whereas appreciable amounts of Cu, Fe and Zn were probably incorporated directly from solution by adsorption. Scrobicularia appears to have potential as an indicator of the availability of metals in estuaries and results for Cu, Fe, Mn and Zn suggest that there were no important changes in the Tamar estuary between 1969 and 1974.

51047 **Power fluidics and the environment.** Grant, J. (United Kingdom Atomic Energy Authority, Risley, Eng.). *CRC Crit. Rev. Environ. Control;* 7: No. 4, 353-407(Nov 1977).

This paper reviews power fluidics technology in the nuclear industry giving emphasis also on its potential uses in chemical plants and in flood and irrigation control. This is a technology of controlling process fluids by purely hydrodynamic methods, which should increase system reliability by eliminating valves, pumps and other fluid control devices that are often causes of failure. This review indicates that the hydrodynamics of fluidic components are not satisfactorily understood at present and may be more complex than similar theory in electronics.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 51331

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 49427, 49430, 49431, 49432, 50979, 50986, 50998, 50999, 51000, 51001, 51015, 51016, 51075, 51088, 51259, 51260, 51264, 51295, 51330

51048 (ANL—76-88(Pt.3), pp 26-30) **Method for the in situ study of pollutant effects on natural zooplankton communities.** Marshall, J.S.; Van Reken, R. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

A new method was developed and tested for the in situ study of pollutant effects on zooplankton communities in large lakes which does not suffer the limitations of large enclosures. In each of five experiments conducted in northern Green Bay, Lake Michigan, two to four samples of lower epilimnion water for each of four levels of added pollutant (Cd) plus controls were incubated in situ in opaque, polyethylene carboys (2 to 5 gallon size) for 4 to 15 days. In each experiment 2 to 4 additional samples, which were not incubated, were also taken. This new method appears to overcome some of the limitations imposed by the use of large, transparent bags or open-top tubes in large lakes for studies of pollutant effects on zooplankton, at least for short- to intermediate-term effects.

51049 (ANL—76-88(Pt.3), pp 31-33) **Long-term effects of cadmium in Lake Michigan water on average numbers and biomass in laboratory Daphnia population.** Marshall, J.S. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Cadmium has long been recognized as a highly toxic element, but it was not until comparatively recently that concern has been expressed over the impact of anthropogenic emissions of cadmium into the environment. Very little is known about the long-term effects of cadmium on aquatic organisms, although zooplankton now appear to be more sensitive than either phytoplankton or fish and thus may be critical in determining the overall impact of cadmium on plankton-dominated ecosystems, such as the oceans or the Great Lakes. The long-term effect of elevated concentrations of cadmium in Lake Michigan water were studied on laboratory populations of Daphnia galeata mendotae, a species of some importance in all of the Great Lakes. Results indicated that an increase of 0.1 ppd in Lake Michigan would probably not have any readily detectable effect on the population of D. galeata mendotae, although there was no evidence for a true threshold for the effects of chronic Cd stress.

51050 (ANL—76-88(Pt.3), pp 65-71) **Distribution of selected chemical elements in the sediments of southern Lake Michigan.** Robbins, J.A. (Univ. of Michigan, Ann Arbor); Edgington, D.N. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Results are reported from a study of 30 elements measured in cores from forty stations in southern Lake Michigan. The samples were taken from the top of each core (1 to 2 cm) and from 20 to 24 cm below the surface at which depth the sediment is associated with the presettlement era. Sedimentation rates at each station were estimated from the profile of either ^{137}Cs or ^{210}Pb in the core. Trace element analyses were performed using neutron activation and gamma-ray spectrometric methods on whole, dry samples or atomic absorption methods on acid leachates. A summary of the analytical results is presented as the average values for all cores analyzed. Cultural enrichment factors, defined as the ratio of the concentration near the surface to that at depth, are also given. It is clear that most elements shown are not entering the lake in significantly different amounts than they were about 150 years ago. In fact, there are only 10 or 12 elements which are significantly enriched in surface sediments.

51051 (ANL—76-88(Pt.3), pp 72-77) **Method for determining fly ash concentrations in Lake Michigan water.** Burger, J.A. (Beloit Coll., WI); Seils, C.; Tisue, G.T. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Standardized slurries were used to make known additions of fly ash particles to unfiltered Lake Michigan water. Water collected at a depth of 3 m, 10 km SW of Grand Haven, Michigan, during December 1976, was also analyzed. It contained 5.9×10^5 recognizable fly ash particles per liter. The frequency distribution of counts of fly ash particles clearly did not follow a Poisson distribution. This result is consistent with qualitative observations that fly ash particles often occur in groups of two or three. There are two sound reasons to expect such clustering: a fraction of coal fly ash is magnetic and thus self-adhering; and particles collected immediately downstream from an electrostatic precipitator at a local power plant occurred in extensive clusters that showed signs of sintering. This clustering probably is responsible for the observation that the Coulter Counter gave consistently lower estimates of particle concentrations than did scanning electron micrography.

51052 (ANL—76-88(Pt.3), pp 78-81) **Dissolution of Asterionella formosa frustules.** Yaguchi, E.M.; Conway, H.L. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Kinetics of the dissolution of frustules of Asterionella formosa, an important Lake Michigan planktonic diatom, were studied to determine the role of this process in the cycling of silicon in Lake Michigan. The results of this preliminary study will be useful in evaluating field data, developing mathematical models for silicon cycling, and relating frustule dissolution to the cycling of various trace elements.

51053 (ANL—76-88(Pt.3), pp 82-86) **Regeneration of silicon from sediments of the Great Lakes.** Robbins, J.A. (Univ. of Michigan, Ann Arbor); Remmert, K.; Edgington, D.N. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

The role of the sediments in the cycling of silicon in the Great Lakes may have been underestimated. It is commonly held that most, if not all, of the diatom frustules formed by conversion of soluble reactive silicon to amorphous silica in epilimnetic waters, dissolve within the water column. According to this view, recent sediments should have little or no influence on the seasonal transfer of silicon between soluble and biogenic forms. Yet recent investigations have shown for a core from Lake Michigan that intact diatom frustules occur in modern sediments and that there is an appreciable gradient of dissolved silica in pore water near the surface of one sediment-water interface. Similarly, there is large increase in dissolved silica concentration in the bottom meter of the water column. Such gradients imply significant fluxes of silicon to overlying waters. Thus, recent sediments would seem to be at once a sink and a source of silicon in the Great Lakes. The role recent deposits may have in the cycling process was studied in a series of field and laboratory experiments that raise many questions concerning the role of the benthos, the nature of sources of dissolved Si, and seasonal variations in Si release.

51054 (BNL—24431) **Occurrence of human enteroviruses in a groundwater aquifer recharged with tertiary wastewater effluents.** Vaughn, J.M.; Landry, E.F. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 25p. (CONF-780810—1). Dep. NTIS, MF A01.

From Symposium on land treatment of wastewater; Hanover, NH, USA (20 Aug 1978).

Portions of document are illegible.

A two-year study of the impact of human viruses on a tertiary treatment-groundwater recharge system located on Long Island is currently nearing completion. Raw influents, chlorinated tertiary

effluents, and groundwater from beneath a uniquely designed recharge basin were assayed on a weekly basis for the presence of indigenous human enteroviruses and coliform bacteria. While high concentrations of viruses were routinely isolated from sewage influents, the chlorinated tertiary effluents were positive for virus in only 3 of 20 samples. In spite of the high quality effluent being recharged, viruses were detected in the groundwater aquifer on several occasions indicating their ability to percolate through the recharge basin. This finding was confirmed by the results of two poliovirus seeding experiments carried out at the field installation. At both high (75 to 100 cm/hr) and low (6 cm/hr) infiltration rates seeded polioviruses were detected at all sampling levels as well as in the groundwater aquifer, 7.62 m below the recharge basin. It would appear that lower infiltration rates promote better virus removal in the specific type of soil used in this study.

51055 (CONF-770478—P1, pp 299-300) **Outlook for remote sensing in the coastal zone.** Teleki, P.G. (Geological Survey, Reston, VA). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51056 (CONF-770478—P1, pp 361-362) **Remote sensing of water pollution.** Hovis, W.A. Jr. (National Environmental Satellite Service, Washington, DC). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51057 Impact of toxic pollutants. Bradfield, R.E.N.; Rees, C.P. *Effluent Water Treat. J.;* **18**: No. 2, 61-71(Feb 1978).

The impact that synthetic organic chemicals and trace elements and metals can have on aquatic life and human health are discussed. A diagram illustrates the distribution and fate of aquatic pollutants. Toxic action at the cellular level may involve: disrupting enzyme systems, forming stable precipitates with essential metabolites, catalyzing the decomposition of essential metabolites, combining with cell membranes and affecting permeability, and/or replacing structurally important elements in the cell. The initial biochemical action may affect normal body processes and thus affect survival, reproduction, or growth of individuals. At the community level many species die after a poison enters the system. Those remaining may reach enormous population sizes and resistant populations may develop. Biogeochemical cycles of the non-essential elements are of considerable concern and cycles for mercury, arsenic, and tin can now be formulated in some detail. The impact of toxic substances on drinkzng water supplies and the implications for human health are discussed. Control strategies available are: control over the number of new chemicals allowed onto the market each year, control at the source of industrial discharge, monitoring to determine the significance of current and future concentrations of toxic chemicals, studies to assess the carcinogenic risks associated with drinking water, re-evaluation of conventional water treatment methods, and a switch from river waters to groundwaters as a source of public water supplies. References are made to the Safe Drinking Water Act of 1974 and the Federal Water Pollution Control Act of 1972.

51058 Heavy metals in the burrowing bivalve Scrobicularia plana from contaminated and uncontaminated estuaries. Bryan, G.W.; Hummerstone, L.G. (Marine Biological Association, Citadel Hill, Eng.). *J. Mar. Biol. Assoc. U.K.;* **58**: No. 2, 401-419(1978).

Concentrations of ten metals (Ag, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn) have been analysed in the soft tissues of Scrobicularia plana (da Costa) from sites in the Gannel and Camel Estuaries in South-West England. In the Gannel Estuary, which receives wastes from old lead mines, the animals contained about an order of magnitude higher concentrations of lead, cobalt, cadmium and zinc than in the Camel Estuary and higher concentrations of other metals also. Differences were also observed between the sediments. In both populations, less than 50% of the total silver, copper and iron was found in the digestive gland. For the other metals over 50% occurred in this organ and, in large Gannel animals, more than 90% of the lead, cobalt, cadmium and zinc, implying that they are chiefly absorbed from ingested sediment. In the contaminated Gannel animals, all metal concentrations, with the exception of manganese and iron, increased with increasing size. The main contrast in the Camel animals concerned the concentrations of cadmium and zinc which were independent of size. This suggests a possible relationship between the slope of the concentration/size regression and the level of contamination, although differences in growth rate may also be involved. When animals were exchanged between the two estuaries, their metal concentrations approached those of the natives very slowly. Even after a year, concentrations of lead, cobalt, cadmium and zinc in the digestive gland were still markedly different from those of native animals. The use of Scrobicularia as an indicator of metal contamination is discussed. It is concluded that it should normally be regarded as a long-term integrator of the chronic type of contamination usually associated with estuarine sediments.

51059 Selected pollution profiles: North Atlantic, North Sea, Baltic Sea, and Mediterranean Sea. *Ambio;* **7**: No. 2, 75-78(1978).

Data from three reports by the International Council for the Exploration of the Sea were analyzed to obtain a comparative picture of pollution levels in the Baltic, the North Sea, and the North Atlantic. Attention was focused on DDT's, PCB's, and mercury in cod fish and shellfish. The highest levels of all pollutants were found in samples taken from the Southern Bight of the North Sea and from the Irish Sea. In the latter area, the highest residue levels of pesticides and PCB's were found around the Clyde, and the highest levels of mercury were found off the northwest coast of England. In shellfish the levels of both metals and pesticides were low. Metal levels in fish were the same as those previously recorded. Pesticide levels of fish were low and DDT was generally lower than DDE. Numerous weaknesses in data collected in the Baltic Sea area were discussed. Levels of metals and organochlorine pesticide residues in the North Atlantic were similar to or lower than those of the mid and north North Sea. The Irish Sea, the Gulf of St. Lawrence, and the Bay of Biscay appear to be relatively highly contaminated. Additional studies in these areas and from the west or south coast of Ireland would be valuable.

51060 Toxicity of intermittent chlorination to bluegill, Lepomis macrochirus: interaction with temperature. Bass, M.L.; Heath, A.G. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *Bull. Environ. Contam. Toxicol.;* **17**: No. 4, 416-423(Apr 1977).

Ten juvenile bluegill which were acclimated in aquaria to each test temperature (6, 15, 25, and 32 C) for a minimum of 2 weeks were placed in each bioassay container and further acclimated for 48 h before chlorine exposure. A laboratory system was built to simulate the pattern of changes in chlorine concentration of water below a steam-electric generating plant. Chlorine, as calcium hypochlorite, was added to achieve peaks of total residual chlorine concentration of 0.21, 0.31, 0.41, and 0.52 mg/1, respectively, in each of 4 aquarium at the temperatures used in the test. Although there were no deaths at 0.2 mg/1 peak total chlorine, the behavior of the fish exposed at the two highest temperatures indicated that they were under stress. The threshold of 0.3 mg/1 peak total chlorine observed in the study, at which chlorine becomes toxic to bluegills, is rather distinct. (MFB)

51061 Subtidal survey of the Strait of Magellan in the vicinity of the Metula oil spill. Swartz, R.C. (Environmental Protection Agency, Newport, OR); Gallardo, V.A. *Antarct. J. U. S.;* **11**: No. 3, 186-187(Sep 1976).

On 9 August 1974 the oil tanker Metula ran aground on the Satellite Bank (52°33.8'S. 69° 42.1'W.) immediately west of the First Narrows in the Strait of Magellan. The ship spilled an estimated 52,300 metric tons of Arabian light crude and 2,000 tons of bunker C fuel oil into the Strait. Most of the oil was rapidly driven onto the beaches. No attempt was made to disperse the spilled oil or to remove it from the shoreline. We surveyed subtidal benthic communities and sediment oil contamination from the National Science Foundation's research ship Hero during 5—13 April 1976. We encountered a great diversity of subtidal benthic habitats. Sediment types ranged from clays to boulders, and benthic communities appeared to be equally heterogeneous. Quantities of oil were still on the beaches. We found a 25-centimeter-thick oil "mousse" layer 45 centimeters below the surface of the upper intertidal zone at the first beach station. Oil in the east estuary on the southern shore of First Narrows extended from the main channel to the supralittoral zone where it affected Lepidophylum and Salicornia plant communities. The beaches and inlets appear to be a continuing source of oil pollution in the Strait.

51062 Aspects of heavy metal and organohalogen pollution in aquatic ecosystems. Ketchum, B.H. (Woods Hole Oceanographic Institution, MA); Zitko, V.; Saward, D. pp 75-90 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

The following topics are discussed: problems in aquatic ecosystems with special reference to heavy metal pollution of the marine environment; organochlorines in the aquatic environment; and an experimental approach to the study of pollution effects in aquatic ecosystems.

51063 Behavior of mercury in natural systems and its global cycle. Wollast, R. (Univ., Brussels); Billen, G.; Mackenzie, F.T. pp

145-166 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

Chemical transformations of mercury in the aquatic environment are discussed and diagrams are presented for stability of inorganic and organic mercury species. Microbiological transformations of mercury in aquatic environments are discussed with regard to influence of physicochemical conditions, dynamics of bacterial populations in the presence of mercury, and biological turnover of mercury. A global model of the cycle of mercury was constructed and diagrams are presented to show the pre-man cycle and the present day cycle. (HLW)

51064 Mobilization of metals in the Dutch Wadden Sea. Duinker, J.C. (Netherlands Inst. for Sea Research, Texel). pp 167-176 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

The metals copper, zinc, iron, and manganese are mobilized in bottom sediments of the Dutch Wadden Sea into interstitial water, where metal concentrations in solution one to two orders of magnitude higher than in the overlying water have been detected. Exchange of metals between interstitial water and the overlying water can take place under particular hydrographic and meteorological conditions, giving rise to short-term increases in the water phase concentrations. Tidal action and reducing conditions are partly responsible for these mobilization processes; on the other hand they reduce or prevent the net accumulation of metals in the Dutch Wadden Sea. Evidence is given for the existence of a "fine" fraction, probably consisting of colloidal iron and manganese hydrous oxides including trace elements, that resists settling in the natural conditions of the Wadden Sea. This fraction may be responsible, in part, for the removal of the mobilized elements out of the Wadden Sea into the North Sea. This fraction with a relatively high metal content will settle elsewhere, perhaps in the deep ocean. It is suggested that removing the tidal action from an area where these conditions prevail may result in high metal concentrations in interstitial water.

51065 Significance of multielement analyses in metal pollution studies. Coombs, T.L. (Inst. of Marine Biochemistry, Aberdeen, Scotland). pp 187-195 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

Effects of cadmium on the plaice were studied and results are reported with regard to general appearance, tissue concentrations of cadmium, copper, and zinc, and gel-filtration of liver and kidney cytosols. Exposure of the plaice to a sublethal concentration of cadmium, while outwardly resulting in no deleterious effects, in reality caused significant changes in the zinc and copper distributions in the tissues which could result in a conditioned metal deficiency in blood cells, gills, and serum. (HLW)

51066 Accumulation and excretion of heavy metals in organisms. Miettinen, J.K. (Univ. of Helsinki). pp 215-229 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

By the term "heavy metals" we usually understand, at least in the biological context, iron and metals denser than it. Some of these metals, e.g., iron, manganese, copper, cobalt, and zinc, are essential to many organisms, while others are either nonessential, harmful, or outright toxic. However, the concept of "essentiality" is under constant review, and "harmfulness" and "toxicity" vary widely with organism and concentration. All heavy metals are potentially harmful to most organisms at some level of exposure and absorption. Three heavy metals which are toxic to most organisms at the lowest concentrations and which are probably never beneficial to living things are cadmium, mercury, and lead. Due to human activity, their presence in the environment has increased in some areas to levels which threaten the health of aquatic and terrestrial organisms, man included. Especially dangerous situations may arise due to heavy metal compounds, such as methylmercury, which are efficiently enriched from one trophic level to another along the food chains. Information regarding the accumulation and excretion of these three heavy metals and those of their compounds able to persist in the environment has therefore become highly desirable. This review is concerned mainly with mechanisms and rates of absorption and excretion, with particular reference to biological half-times and accumulation. The primary emphasis is on accumulation in man, although other organisms, especially fish and shellfish which are important constituents of food chains leading to man, are also briefly treated. Only the most recent results and viewpoints are discussed, without full coverage of the earlier literature. In this respect, reference is made to the recent report of an international Task Group on Metal Accumulation (1973), which reviews the literature extensively.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 50749, 50948, 50979, 51001, 51002, 51003, 51007, 51008, 51331

51067 (ANL—76-88(Pt.3), pp 34-36) **Particle size and chemical phase distribution of plutonium in an estuarine sediment.** Alberts, J.J.; Muller, R.N.; Orlandini, K.A. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Plutonium in Lake Michigan sediments has been shown to be associated predominantly with hydrous oxides and exhibits an activity maximum in particles less than 4 μm in diameter. However, since plutonium exhibits variable size and charge characteristics in waters of differing ionic strength and chemical composition, an investigation was undertaken to determine if the particle size and chemical fraction distribution of plutonium in other sediments might be different. A sample of marine sediment was collected from 60 ft of water in Buzzard's Bay, Massachusetts, with sealed Smith-MacIntyre grab having a surface area of approximately 1 ft^2. The loose floc layer overlying the consolidated sediment was removed by suction and was lyophylized. Three subsamples of the dry material were taken for determination of the ash/dry weight ratios and total $^{239,240}Pu$ concentration; sequential extraction to determine the distribution of plutonium among various chemical fractions of the sediment; and separation into five size classes by wet sieving and elutriation in a carbonate-oxalate dispersant, followed by the determination of the $^{239,240}Pu$ concentration in each size class. The results of the sequential extraction clearly indicate that most of the $^{239,240}Pu$ is found in the citrate-dithionite extract as is the case for Lake Michigan sediments.

51068 (ANL—76-88(Pt.3), pp 37-39) **Effect of anaerobiosis on the geochemical cycling of plutonium in PAR Pond.** Alberts, J.J.; Orlandini, K.A.; Corey, J.C. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Most of the fallout plutonium in Lake Michigan sediments is found associated with hydrous oxides which are significantly solubilized only under reducing conditions. As most of the sediments of Lake Michigan remain aerobic all year long, the possibility of resolubilization of these oxides and reintroduction of the associated plutonium into the overlying water through this mechanism is small. However, in some water bodies, such as PAR Pond, South Carolina, anaerobic sedimentary conditions do prevail for a portion of the year. PAR Pond was studied to determine if the seasonal anaerobic conditions in the sediments lead to a measurable increase in the plutonium concentration of the overlying water. The data indicated that there was a slight increase in the $^{239,240}Pu$ concentration near the bottom as compared to the rest of the water column in the July 1975 and August 1976 samples. However, no significant increase in $^{239,240}Pu$ concentration was observed in the hypolimnetic waters of the pond which could be related to the anaerobic conditions of the sediment and deep waters during the summer months.

51069 (ANL—76-88(Pt.3), pp 40-42) **Plutonium distribution in various tissues of fish from a contaminated pond-canal system in the midwestern United States.** Alberts, J.J.; Bartelt, G.E.; Wayman, C.W. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

A system of canals and ponds exists near the Mound Laboratory in Miamisburg, Ohio, which contains high concentrations of ^{238}Pu in the sediments (up to approximately 0.5 nCi/g) and overlying waters as a result of a spill in 1969. The system contains several species of fish which represent a possible food source for man. The tissue distribution of ^{238}Pu within specimens of gizzard shad, bluegill, crappie, smallmouth bass, largemouth bass, black bullhead, and carp was determined. The results of this study indicate that there is little transfer of plutonium to the muscle and skin of freshwater fish even though the fish have lived in a relatively contaminated environment. As these are the tissues most often consumed, it would appear that there is little transfer of plutonium through this pathway to man.

51070 (ANL—76-88(Pt.3), pp 47-49) **Preliminary report on the dispersion and transport of plutonium from a pulsed effluent in a river system.** Alberts, J.J. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

The fate of the small quantities of plutonium discharged into a flowing stream via the effluent from the Mound Laboratory was studied. In order to define the processes controlling the fate of plutonium in the Great Miami River system, a comprehensive field study was undertaken during October 1976. Rhodamine WT dye was added as a readily detectable marker to the low level waste storage tanks at the plant and this pulse was followed downstream over a period of days at comprehensive water sampling stations at five locations. Preliminary data are reported on fluorescence of the dye and chemical speciation of Pu in the samples.

51071 (ANL—76-88(Pt.3), pp 50-52) **Distribution of fallout plutonium in the waters of the lower Great Lakes.** Alberts, J.J.; Wahlgren, M.A.; Nelson, D.M. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

The concentrations of fallout ^{239,240}Pu in the surface waters from all the Great Lakes were slightly lower in 1976 samples than in those from 1973. The same trend of higher concentrations in the surface waters of the upper lakes as in the surface waters of the lower lakes was observed for both years. In addition, the ^{239,240}Pu concentration in samples of deep water collected during the summer of 1976 was higher than in the surface waters but was similar to the surface water values of the 1973 spring samples. This observation is significant in that it suggests that the surface waters of all the Great Lakes undergo a seasonal decrease in plutonium concentration similar to that already observed in Lake Michigan.

51072 (ANL—76-88(Pt.3), pp 53-55) **Seasonal cycling of plutonium in Lake Michigan.** Wahlgren, M.A.; Nelson, D.M. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

During the summer of 1973 the concentration of fallout ^{239,240}Pu in the surface water of Lake Michigan became markedly depleted, coincident with the formation of a stable thermocline. Seasonal cycling of Pu was followed from 1973 through 1976 and showed significant inputs of new fallout plutonium occurred during 1974 and 1975. Although the new inputs of fallout plutonium are almost negligible compared to the total already in the system, this is not true for the water column which at present contains only 3% of the integrated deposition on the lake. The epilimnion is especially sensitive to new atmospheric deposition because it is physically isolated from dilution with the much larger hypolimnetic volume for a period of several months. The data for total (dissolved and suspended) plutonium concentrations in Lake Michigan surface water are presented.

51073 (ANL—76-88(Pt.3), pp 56-60) **Comparison of the distribution coefficients of plutonium and other radionuclides in Lake Michigan to those in other systems.** Wahlgren, M.A.; Nelson, D.M. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Filtration of Lake Michigan water samples has been carried out routinely since 1973, and some plutonium concentrations in the seston have been reported. During 1975 and 1976 a sufficient number of filter samples from various depths was obtained throughout the field seasons to establish whether or not a distribution coefficient also controls the uptake of plutonium by the formation of particulates and their settling from the surface waters. Samples from ANL station 5 (10 km SW of Grand Haven, Michigan, water depth 67 m), of the southern basin, and from the lower Great Lakes have been analyzed for dry weight, ash weight, total organic (loss of weight on ignition), amorphous silica, calcite, and residual minerals. Distribution coefficients were calculated on the basis of each of these solid components, and self-consistent values were observed for depth, season, or lake only, on the basis of dry weight of seston. The findings strongly suggest that the uptake of fallout plutonium (including inputs of new fallout during the summer of 1975) is dominated by a surface coating process common to all seston particle types. An insufficient number of ^{137}Cs analyses were obtained to correlate its uptake to a specific component of the seston, but its behavior is clearly different from that of plutonium.

51074 (ANL—76-88(Pt.3), pp 61-64) **Sorption of ^{237}Pu by the diatom Asterionella formosa.** Conway, H.L.; Wahlgren, M.A.; Peterson, N.; Nelson, D.M. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Knowledge of the behavior of the man-made radionuclide plutonium within aquatic environments is of fundamental importance in assessing its potential hazards and ecological impact. The sorption of plutonium by phytoplankton and other algae is the dominant factor in the biological transport of plutonium in the aquatic environment, and it has been suggested that sorption by phytoplankton may be responsible for the seasonal loss of plutonium from the epilimnion of Lake Michigan. A unialgal diatom culture was spiked with ^{237}Pu tracer solution in an attempt to simulate the behavior of fallout plutonium observed in field studies. The results were encouraging in that the ^{237}Pu in the filtered lake water medium exhibited strongly anionic properties similar to fallout plutonium in Lake Michigan, with limited sorption on container walls. The purpose of the present study was to extend the investigations of the sorption of plutonium by phytoplankton in a controlled environment using continuous culture techniques.

51075 (ANL—76-88(Pt.3), pp 87-92) **Comparative lead-210, cesium-137, and pollen-geochronologies of recent sediments from Lakes Erie and Ontario.** Robbins, J.A. (Univ. of Michigan, Ann Arbor); Edgington, D.N.; Kemp, A.W.L. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Several methods were employed to determine rates of accumulation of recent sediments in the Great Lakes. The naturally occurring radionuclide, lead-210, was used to measure sedimentation rates. Geochronology with lead-210 is based on the radioactive decay of the isotope following burial in sediments. This method can reveal changes in sedimentation occurring over the past 100 years or so. Although more limited in its application, the distribution of fallout cesium-137 can also be used to obtain estimates of recent sedimentation rates. Geochronology with cesium-137 is based on the occurrence of a horizon in sediments corresponding to the onset of nuclear testing about 25 years ago. Ragweed pollen profiles were used to determine sedimentation rates in relation to the presence of a sedimentary horizon associated with a dramatic increase in ragweed vegetation following forest clearance in the mid-1800's. Both of these latter methods, relying as they do on the appearance of a horizon event, provide a measure of average rates of sedimentation over approximately the past 25 and 130 years, respectively.

51076 (NVO—178, pp 449-476) **Transuranic speciation in the environment.** Bondietti, E.A.; Sweeton, F.H. (Oak Ridge National Lab., TN). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

The speciation of transuranium elements in the environment was discussed with particular emphasis on Pu. The thermodynamic approach to evaluating Pu speciation was reviewed and examples presented to exemplify the complexities of Pu chemistry in aqueous solutions. An example of the actual evaluation of Pu oxidation states in natural water was presented. The results, which indicated that Pu(III) and/or Pu(IV) dominated the soluble Pu fraction, were compared to a simple model involving the hydrolytic species of Pu(IV). Literature data were also evaluated with respect to the Pu(IV) model. In all cases, the soluble concentrations of Pu in natural waters were in reasonable agreement with the model. Dissolution studies with PuO_2 were reviewed and data presented to demonstrate that oxidized Pu (Pu(V) and/or Pu(VI)) species may be responsible for the relatively high Pu concentrations reported. The mechanism of oxidation appeared to be related to radiolytic effects. The plant uptake of transuranium elements was discussed and the influence of actinide oxidation state illustrated. Plutonium in one soil-plant uptake experiment resembled Th more than U in plant availability.

51077 (NVO—178, pp 477-487) **Distribution patterns and transport of plutonium in freshwater environments with emphasis on primary producers.** Eyman, L.D.; Trabalka, J.R. (Oak Ridge National Lab., TN). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

The major repository for transuranic elements entering aquatic ecosystems is the bed sediment. Observed K/sub d/ values for plutonium across a wide spectrum of aquatic systems are surprisingly uniform (on the order of 10^5). Plutonium arrives at the bed sediment as a result of association with and subsequent settling of suspended particulate matter. Consequently, the major role of phytoplankton in plutonium kinetics in aquatic systems has been postulated to be one of plutonium removal from the water column. The very high affinity of plutonium for particulate matter in aquatic systems makes it difficult to use the traditional expression of Concentration Factor (CF) as a measure of the tendency of biota to accumulate this element. A proposed term, Trophic Transfer Factor (TTF), relates concentrations observed in biota to that of the sediment. The underlying assumption is that, due to the high K/sub d/'s, accumulation in tissues of organisms at higher trophic levels will be dominated by gut absorption rather than by direct uptake from water. Plutonium in most freshwater systems is transported predominately in association with suspended particulate matter. In some organically rich systems, a fraction of the hydrologically mobile plutonium pool may be

complexed or otherwise associated with naturally occurring organic acids. Although this association may result in increased environmental mobility, it does not appear to result in increased availability to aquatic biota.

51078 (NVO—178, pp 505-516) **Distribution of ^{238}Pu and ^{239,240}Pu in aquatic macrophytes from a midwestern watershed.** Wayman, C.W.; Bartelt, G.E.; Alberts, J.J. (Argonne National Lab., IL). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Aquatic macrophytes were collected in the Great Miami River, Ohio, above and below Miamisburg and in the canal and ponds, near the Mound Laboratory, which contain sediments of a high activity (approximately 10^3 to 10^6 times) relative to the river sediments. Macrophytes collected in the river below Miamisburg have higher activities of ^{238}Pu than those collected from above the city. Macrophytes from the canal and ponds contain high specific activities of ^{238}Pu and ^{239,240}Pu with the exception of cattails grown in the ponds. Concentration factors are reported and discussed with reference to possible modes of plutonium accumulation and distribution within the plants.

51079 (NVO—178, pp 517-529) **^{238}Pu and ^{239,240}Pu distribution in fish and invertebrates from the Great Miami River, Ohio.** Bartelt, G.E.; Wayman, C.W.; Groves, S.E.; Alberts, J.J. (Argonne National Lab., IL). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Samples of minnows, shad, goldfish, carp, crayfish, and clams were taken from the Great Miami River in the vicinity of Miamisburg, Ohio. Activities of ^{238}Pu and ^{239,240}Pu are reported for these organisms. In addition, distributions were determined for plutonium between the gastrointestinal tract and the remainder of the organism in carp and between the shell and soft parts of crayfish. The results are discussed with regard to the spatial distribution of the organisms around Miamisburg and the tissue distribution within the animals.

51080 (NVO—178, pp 531-543) **Effect of naturally occurring organics on plutonium-237 uptake by algae and bacteria.** Giesy, J.P. Jr. (Savannah River Ecology Lab., Aiken, SC); Paine, D.; Hersloff, L.W. Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

Naturally occurring organics were concentrated from Skinface Pond, near Aiken, South Carolina and separated into four nominal diameter size fractions (F I > 0.0183; 0.0183 > F II > 0.0032; 0.0032 > F III > 0.009; F IV < 0.009 μm) by membrane ultrafiltration. Each fraction was introduced into Scenedesmus obliquus and Aeromonas hydrophila cultures at concentrations equal to those found in nature to determine their effects on ^{237}Pu uptake. Plutonium-237 uptake was determined in log phase cultures after 6 hr incubations. The initial plutonium concentration in each flask was 1.1 x 10^{-4} μCi/ml $^{237}Pu^{+4}(NO_3)_4$. Fractions I and II significantly reduced ^{237}Pu uptake by S. obliquus, while F IV increased uptake and F III had no effect. Plutonium-237 uptake by A. hydrophila was not significantly different in the presence of F I, F II or F III than tryptic broth medium alone, while F IV significantly increased ^{237}Pu uptake.

51081 (UCRL—80312) **Applications of in situ gamma-ray spectrometry.** Ragaini, R.C.; Kirby, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Apr 1978. Contract W-7405-ENG-48. 42p. (CONF-780542—1). Dep. NTIS, PC A03/MF A01.

From American Nuclear Society topical conference final program; Mayaguez, Puerto Rico (30 Apr 1978).

Gamma-ray spectrometric methods using high-resolution Ge(Li) and high purity Ge detectors have been used to quantify the concentrations and external exposure rates of radionuclides in the soil. These in situ methods have been used to study radionuclide deposition around nuclear power stations, the distribution of radionuclides at the Nevada Test Site, biogeochemical cycling of radionuclides, and the fate and impact of fallout radionuclides. Portable gamma-ray spectrometer systems used for various kinds of in situ field measurements include: large-volume coaxial Ge(Li) detectors for terrestrial gamma-ray surveys at several sites including preoperational nuclear power plants and for real-time measurements of nuclear reactor plume isotopic exposure rates; and planar, high purity Ge detectors for mapping ^{241}Am and ^{239}Pu soil concentrations, particularly at the Nevada Test Site. These applications are discussed along with a brief description of the methodology and techniques associated with in situ gamma-ray spectrometry.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 51001

THERMAL EFFLUENTS MONITORING AND TRANSPORT

51082 (ANL—76-88(Pt.3), pp 9-13) **Thermal plume residence and temperature exposure of salmonid fishes.** Spigarelli, S.A.; Romberg, G.P.; Thommes, M.M.; Prepejchal, W. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

A nondestructive echo-location technique was used to estimate the density-distribution patterns of fish and to determine the influence of discharge design and location on fish attraction. Studies were conducted between 1972 and 1975 at the Point Beach and Zion nulcear power plants and Waukegan fossil-fuel power plant on Lake Michigan. Preliminary inspection of results indicates seasonal attraction of abundant species, such as alewife, trout, and salmon. In general, fish densities in the plume area tend to be elevated relative to unheated areas during spring and early summer. Power plant location and discharge type apparently affect the magnitude and timing of attraction to discharges. Fish in plume areas generally are observed at elevated temperatures or near temperature interfaces. Data analyses include conventional approaches to detect differences in mean densities over time and space and recent developments in time-series analysis. Predictability of fish responses will depend on the identification of temporal and spatial distribution patterns.

51083 (CONF-770478—P2, pp 1227) **Mapping diurnal variations in chlorophyll "a", transparency, and surface temperatures in the New York Bight.** Polcyn, F.C. (Environmental Research Inst. of Michigan, Ann Arbor); Clark, D.; Zaitzeff, J. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51084 (NUREG/CR—0077) **Effects of nuclear power plant operations on populations of boring and fouling organisms. [Progress report, September 1—November 30, 1977].** Hoagland, K.E.; Crockett, L.; Rochester, M. (Lehigh Univ., Stone Harbor, N.J. (USA). Wetlands Inst.). Mar 1978. 50p. NTIS $5.25.

The power plant was operating during the fall of 1977. The temperature elevation in Oyster Creek was between 3.5° and 6°C. Salinities in Oyster Creek and Forked River vary more than salinities in Barnegat Bay. Teredo spp. settle later into the fall than Bankia gouldi. Several Teredos settled in Oyster Creek in September and October. They also settled on Long Beach Island, but at no other stations. Comparison of hydrography with shipworm settlement patterns indicates that shipworm larvae are abundant in regions of rapidly moving water and require only very localized quiet areas for successful settlement. Shipworm settlement in Oyster Creek in the fall of 1976 was not great enough to affect the population structure significantly. Settlement in the fall of 1977 was detectable in November's population size structure. Teredo spp. dominate borer communities on Long Beach Island, while Bankia is more common along the inner side of Barnegat Bay. Shipworms continued to grow in the fall of 1977, even at stations outside the thermal plume. Shipworm damage in Oyster Creek and Forked River remains significant.

51085 **Dishonest method in stream temperature modeling.** Morse, W.L. (Bonneville Power Administration, Portland, OR). *Water Resour. Res.;* **14**: No. 1, 45-51(Feb 1978).

The unidimensional form of the thermal energy conservation principle as a quasi-linear partial differential equation (PDE) has been shown accurate for point temperature forecasts on completely mixed streams and river-run reservoir systems. Two methods of solution are presented which lead to a unique solution. Yet this nonrandom solution is contrary to the behavior of nature, and so a philosophic change is introduced. From the PDE subsidiary differential system a stochastic differential equation (SDE) is obtained with random forcing function from the meteorologic and forebay-depth analyses. With random initial conditions (time-averaged components of the in situ water temperature vector) the SDE is then recast as a random nonlinear Volterra integral equation (RIE). Then a solution to the random-initial-conditions RIE (fixed points of the expectations), by the so-called dishonest method (Keller, 1962), is compared with a solution obtained by repetitively solving the PDE as a random equation (expectations of the fixed points). Of course, these solutions, obtained by "dishonest and honest" methods, are not necessarily unique, but they may be suffiifiently close in some sense. Hence proper interpretation and use of this RIE model would enable water resource planners economically to determine stream tempera-

tures in probability during critical climatic or river flow conditions. And then intelligent planning and scheduling could avoid some catastrophic aquatic event which might occur as a result of extreme water temperatures.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 50430, 50440, 50447

51086 (CONF-770478—P2, pp 1239) **Application of LANDSAT to mapping inland lake water quality and watershed land use.** Rogers, R.H.; McKeon, J.B. (Bendix Aerospace Systems Div., Ann Arbor, MI). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51087 **Superspill: black day for Brittany.** Grove, N. *Natl. Geogr. Mag.;* **154**: No. 1, 124-135(Jul 1978).

Both environmental and economic impacts of history's largest oil spill are presented with many colored photographs. (PCS)

REGULATIONS

REFER ALSO TO CITATION(S) 50425, 50429, 50446, 51057

51088 (CONF-770478—P2, pp 1639-1640) **U.S. Coast Guard airborne oil surveillance systems: status report.** Maurer, A.T. (Coast Guard Headquarters, Washington, DC); Edgerton, A.T.; Meeks, D.C. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 49775, 50415

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 49429, 50417, 50425, 50430, 50547

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 50417, 50425, 50426, 50427, 50430, 50524

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 49978, 50427

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 51122, 51242

51089 **Relatively brief environmental enrichment aids recovery of learning capacity and alters brain measures after postweaning brain lesions in rats.** Will, B.E. (Univ., Strasbourg); Rosenzweig, M.R.; Bennett, E.L.; Hebert, M.; Morimoto, H. *J. Comp. Physiol. Psychol.;* **91**: No. 1, 33-50(1977).

Enriched postlesion experience aided in overcoming effects of simultaneous bilateral cerebral lesions made at 30 days of age in one experiment with inbred Fischer rats and in a second experiment with the Berkeley S_1 strain. The lesions were directed to the occipital cortex, but in most cases there was also some impairment of the hippocampus. For 60 days after operations, half of the rats lived in small individual cages and half lived in groups in large enriched-environment cages. They were then pretrained and tested on the standard 12 Hebb-Williams problems. Daily injections of methamphetamine (vs. saline) during the period of differential experience in the first experiment produced no effect on the behavioral scores. The second experiment included groups that received only 2 hr/day of enriched experience, and they benefited as much as groups that remained in the enriched environment 24 hr/day. The results of both experiments demonstrated significant beneficial effects of environment when bilateral lesions were made at a later age and when the periods of enriched experience were shorter than had previously been tested. Two additional experiments revealed significant effects of both lesions and environment on weight and RNA/DNA of brain regions.

51090 **Apollo-Soyuz light-flash observations.** Budinger, T.F. (Univ. of California, Berkeley); Tobias, C.A.; Huesman, R.H.; Upham, F.T.; Wieskamp, T.F.; Hoffman, R.A. pp 141-146 of Cospar: life sciences and space research. Vol. XV. Holmquist, R.; Stickland, A.C. (eds.). New York; Pergamon Press (1977).

While dark adapted, two Apollo-Soyuz astronauts saw eighty-two light flash events during a complete 51 orbit which passed near the north magnetic pole and through the South Atlantic Anomaly. The frequency of events at the polar parts of the orbit is 25 times that noted in equatorial latitudes and no increased frequency was noted in the South Atlantic Anomaly at the 225-km altitude. The expected flux of heavy particles at the northern and southern points is 1 to 2 min^{-1} per eye, and the efficiency for seeing HZE particles which were below the Cerenkov threshold is 50%.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 49340, 49415, 50786, 51015, 51046, 51058, 51117, 51133, 51142, 51146, 51222, 51232, 51276, 51282

51091 (ANL—76-88(Pt.3), pp 3-5) **Diurnal photosynthesis and stomatal resistance in field-grown soybeans.** Miller, J.E.; Muller, R.N.; Seegers, P. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

The process of photosynthesis in green plants is the major determinant of crop yield. Although the effects of air pollutants, such as sulfur dioxide, on photosynthesis has been studied, many unsolved questions remain. This is especially true with regard to reduction of photosynthetic rate under conditions of chronic exposure causing little or no visible injury. It was the purpose of these studies to develop techniques suitable for measuring photosynthetic rates of field-grown plants without dramatically altering the microenvironment of the plants. Gross photosynthetic rates of soybeans (Glycine max. cv. Wayne) in the field were measured by exposing a small section of representative leaves for 30 seconds to $^{14}CO_2$ in a normal atmospheric mixture by a technique similar to that of Incoll and Wright. A 1-cm^2 section of the area exposed to $^{14}CO_2$ is punched from the leaf and processed for liquid scintillation counting. Since the treatment period is of such short duration, there is little photorespiratory loss of $^{14}CO_2$, and thus, the amount of ^{14}C fixed in the leaf can be related to the gross photosynthetic rate. Other parameters measured during the course of these experiments were stomatal resistance, light intensity, leaf water potential, and air temperature.

51092 (UR—3490-1374) **Crystallographic studies of drug—nucleic acid crystalline complexes and their biological implications.** Sobell, H.M.; Jain, S.C.; Sakore, T.D.; Reddy, B.S.; Bhandary, K.K.; Seshadri, T.P. (Rochester Univ., N.Y. (USA)). 1978. Contract EY-76-C-02-3490. 40p. (CONF-780148—1). Dep. NTIS, PC A03/MF A01.

From Symposium on biomolecular structure, conformation, function and evolution; Madras, India (4 Jan 1978).

It is now over a decade since Lerman proposed his intercalation hypothesis to explain the strong binding mode of the aminoacridines to DNA. A large body of evidence now supports this concept, and it has become increasingly apparent that (in addition to the aminoacridines) a large number of additional drugs and dyes bind to DNA by intercalation. The technique of molecular cocrystallization as developed in our laboratory has provided an opportunity to obtain detailed stereochemical information about interactions between many of these drugs and nucleic acid components and this has led to unifying structural concepts in understanding a large number of drug-DNA interactions. This paper will summarize the results of our crystallographic studies of drug-nucleic acid crystalline complexes done in recent years. It also discusses their broader biological implications in further detail.

51093 Sensitive fluorescence assays for urokinase using synthetic peptide 4-methoxy-β-naphthylamide substrates. Bigbee, W.L.; Weintraub, H.B.; Jensen, R.H. (Lawrence Livermore Lab., CA). *Anal. Biochem.;* **88**: No. 1, 114-122(15 Jul 1978).

Two assays for the plasminogen activator urokinase using peptide fluorogenic substrates are described. N-carbobenzoxy—glycyl-glycyl-L-arginine-4-methoxy-β-naphthylamide (CBZ-Gly-Gly-Arg-4MβNA) can be used in a direct assay that is simple, rapid, and sensitive to as little as 0.5 IU/ml urokinase. Additional sensitivity, to 0.01 IU/ml urokinase, is obtained in a second method that uses plasminogen as the primary substrate followed by a fluorogenic substrate assay employing N-carbobenzoxy-L-ananyl-L-alanyl-L-lysine-4-methoxy-β-naphthylamide (CBZ-Ala-Ala-Lys-4MβNA) as a specific substrate for the activated plasmin. These assays are as sensitive as the best assays presently in use and are simpler to perform. In addition, these assays can readily be used for kinetic analysis of the hydrolytic activity of urokinase or other plasminogen activators.

51094 Proteases induce secretion of collagenase and plasminogen activator by fibroblasts. Werb, Z.; Aggeler, J. (Univ. of California, San Francisco). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 4, 1839-1843(Apr 1978).

We have observed that treatment of rabbit synovial fibroblasts with proteolytic enzymes can induce secretion of collagenase (EC 3.4.24.7) and plasminogen activator (EC 3.4.21.-). Cells treated for 2 to 24 hr with plasmin, trypsin, chymotrypsin, pancreatic elastase, papain, bromelain, thermolysin, or α-protease but not with thrombin or neuraminidase secreted detectable amounts of collagenase within 16 to 48 hr. Treatment of fibroblasts with trypsin also induced secretion of plasminogen activator. Proteases initiated secretion of collagenase (up to 20 units per 10^6 cells per 24 hr) only when treatment produced decreased cell adhesion. Collagenase production did not depend on continued presence of proteolytic activity or on subsequent cell adhesion, spreading, or proliferation. Routine subculturing with crude trypsin also induced collagenase secretion by cells. Secretion of collagenase was prevented and normal spreading was obtained if the trypsinized cells were placed into medium containing fetal calf serum. Soybean trypsin inhibitor, α_1-antitrypsin, bovine serum albumin, collagen, and fibronectin did not inhibit collagenase production. Although proteases that induced collagenase secretion also removed surface glycoprotein, the kinetics of induction of cell protease secretion were different from those for removal of fibronectin. Physiological inducers of secretion of collagenase and plasminogen activator by cells have not been identified. These results suggest that extracellular proteases in conjunction with plasma proteins may govern protease secretion by cells.

51095 Exoribonuclease from Saccharomyces cerevisiae: effect of modifications of 5′ end groups on the hydrolysis of substrates to 5′ mononucleotides. Stevens, A. (Oak Ridge National Lab., TN). *Biochem. Biophys. Res. Commun.;* **81**: No. 2, 656-661(30 Mar 1978).

Using poly(A) as a substrate, an exoribonuclease has been purified from the high-salt wash of ribosomes of Saccharomyces cerevisiae. The product of the reaction of the exoribonuclease is 5′ AMP. Hydrolysis of [^{3}H](pA)$_5$[^{14}C](pA)/sub n/ shows that both labels are released at the same rate, suggesting that the enzyme acts in a processive manner. Removal of the terminal phosphate of poly(A) with alkaline phosphatase reduces the rate of hydrolysis by 80%. Treatment of the terminally dephosphorylated poly(A) with polynucleotide kinase restores the activity. Two 5′ capped mRNA's have been tested and they are hydrolyzed slowly, if at all, by the enzyme. In contrast, phage T4 mRNA, ribosomal RNA, and encephalomyocarditis viral RNA are hydrolyzed at greater than 50% of the rate of poly(A).

51096 Reversible modification of arginine residues with glyoxal. Glass, J.D.; Pelzing, M. (Mount Sinai School of Medicine, New York). *Biochem. Biophys. Res. Commun.;* **81**: No. 2, 527-531(30 Mar 1978).

Glyoxal reacts with arginine to yield several ninhydrin reactive adducts. One of these, the product favored in strongly acidic solutions, decomposes in the presence of o-phenylenediamine with regeneration of free arginine. Reversible modification of an arginine residue in a peptide has been demonstrated. The conditions for reversibly blocking the guanidino group with glyoxal differ in some respects from those reported for reversible blocking of arginine sidechains with cyclohexanedione. It appears that the two dicarbonyl reagents, glyoxal and cyclohexanedione, might be complementary in their applications to reversible protein modification and to polypeptide semisynthesis.

51097 Conformational changes of the chromatin subunit. Gordon, V.C. (Univ. of California, Los Angeles); Knobler, C.M.; Olins, D.E.; Schumaker, V.N. *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 2, 660-663(Feb 1978).

Hydrodynamic studies on monomer chromatin subunits (ν_1) as a function of ionic strength (0.7 mM to 100 mM KCl) indicate two salt-dependent conformational transitions. An abrupt transition occurs at about 7.5 mM ionic strength. Decreasing the ionic strength from 10 to 5 mM results in a decrease in s/sub 20,w/ of the ν_1 from 11.1 to 9.9 S. The diffusion coefficient D/sub 20,w/ decreases from 3.3 to 2.7 x 10^{-7} cm^2 sec^{-1}. The ν_1 crosslinked with formaldehyde at 10 mM ionic strength do not undergo a similar salt-dependent change in s/sub 20,w/. Another transition is observed at about 1 mM ionic strength; s/sub 20,w/ decreases to 9.4 S and D/sub 20,w/ decreases to 2.2 x 10^{-7} cm^2 sec^{-1}. Throughout the entire salt range the molecular weight of the ν_1 remains reasonably constant, implying that salt-dependent changes in the frictional coefficient are being observed. Various hydrodynamic models are considered as possible interpretations of the observed changes in the frictional coefficient.

51098 Purification and translation of zein messenger RNA from maize endosperm protein bodies. Burr, B. (Brookhaven National Lab., Upton, NY); Burr, F.A.; Rubenstein, I.; Simon, M.N. *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 2, 696-700(Feb 1978).

The messenger RNAs coding for the zein storage protein have been purified from other contaminating RNAs. The average molecular lengths are 1.1 to 1.2 kilobases, as determined by polyacrylamide gel electrophoresis and by electron microscopy. Products of messenger-dependent protein synthesis in vitro appear to be 1100 and 2000 daltons heavier than the native polypeptides. Zein is like secretory proteins in having a precursor with an additional amino-terminal sequence. Although only one mRNA is seen in polyacrylamide gel electrophoresis, the combined size of the polypeptide products formed exceeds the coding capacity for one message of the size determined in this study. This suggests that there are at least two mRNAs of similar sizes for the zein polypeptides rather than one dicistronic message.

51099 Repair of depurinated DNA in vitro by enzymes purified from human lymphoblasts. Bose, K.; Karran, P.; Strauss, B. (Univ. of Chicago). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 2, 794-798(Feb 1978).

Alkali-labile lesions introduced into T7 DNA by treatment with methyl methanesulfonate were removed and the DNA was repaired by incubation with DNA polymerase α and nuclease from a human lymphoblastoid line followed by the addition of DNA ligase. The nuclease preparation contains both apurinic endonuclease and 5′-3′ exonuclease activities. Dinucleotides appear to be the first product of exonuclease action. Repair of methyl methanesulfonate-induced damage can occur by the insertion of only a few nucleotides per lesion as in vivo.

51100 Effects of potassium dichromate on nucleic acid and protein syntheses and on precursor uptake in BHK fibroblasts. Levis, A.G.; Butignol, M.; Bianchi, V.; Sponza, G. (Univ., Padua). *Cancer Res.;* **38**: No. 1, 110-116(Jan 1978).

Treatments for 1 to 4 hr with 10^{-4} M potassium dichromate, a soluble hexavalent chromium salt with a strong oxidizing power, markedly reduce DNA and RNA accumulation rates in hamster fibroblasts grown in vitro (BHK line), as shown by quantitative spectrophotometric determinations. Such inhibitory action is not immediately evident on the basis of the incorporation rates of labeled nucleosides into DNA and RNA, as dichromate affects also the relative concentrations of labeled precursors in the intracellular pool. Dichromate first stimulates and then inhibits nucleoside (mostly thymidine) uptake, whereas amino acid uptake is immediately inhibited. Actual rates of macromolecular syntheses have been calculated by taking into account the induced changes of soluble precursor concentrations; such normalized rates point out that dichromate induces a sudden blockage of DNA replication, whereas RNA and protein syntheses are secondarily inhibited. The observed cytotoxic effects of dichromate are tentatively referred to the oxidation of cell components by hexavalent chromium and thereby to the interaction of reduced trivalent chromium with specific biological ligands on cell membrane and on DNA.

51101 Time-resolved resonance Raman spectroscopy of bacteriorhodopsin on the millisecond timescale. Terner, J.; Campion, A.; El-Sayed, M.A. (Univ. of California, Los Angeles). *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 12, 5212-5216(Dec 1977).

A simple technique is described that uses a continuous wave laser with electromechanical modulation to obtain time-resolved Raman spectra of transient species on the millisecond timescale. The time behavior of the vibrational bands of the intermediates involved in the proton pumping of bacteriorhodopsin is determined. From these results, along with resonance enhancement and power dependence studies, the bands that appear in the continuous wave Raman spectrum of bacteriorhodopsin can be assigned to three intermediates in the photochemical cycle of bacteriorhodopsin, bR_{570}, bL_{550}, and bM_{412}. The Raman spectra of bR_{570} and bM_{412} are compared with published spectra of model Schiff bases of all-trans and 13-cis retinal.

51102 Identification of the major adducts formed by reaction of benzo[a]pyrene diol epoxide with DNA in vitro. Straub, K.M.; Meehan, T.; Burlingame, A.L.; Calvin, M. (Univ. of California,

Berkeley). *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 12, 5285-5289(Dec 1977).

Covalent binding of the benzo[a]pyrene metabolite (+-)7β,8α-dihydroxy-9α,10α-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene to calf thymus DNA was investigated. Enzymatic hydrolysis of the carcinogen-modified DNA and subsequent separation via reversed-phase high-pressure liquid chromatography resulted in the detection and isolation of seven distinct products. High-resolution mass spectrometry indicates that these products are covalent adducts of deoxyguanosine, deoxyadenosine, and deoxycytidine. The deoxyguanosine and deoxyadenosine adducts involve binding between the activated hydrocarbon (benzo[a]pyrene diol epoxide) and exocyclic amino groups of the respective purines.

51103 High resolution two-dimensional electrophoresis of human plasma proteins. Anderson, L.; Anderson, N.G. (Argonne National Lab., IL). *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 12, 5421-5425(Dec 1977).

The two-dimensional electrophoretic technique of O'Farrell has been adapted to the analysis of human plasma proteins, and 30 polypeptides have been identified in the pattern produced. Genetic variants involving charge (isoelectric point) or size (molecular weight in the presence of sodium dodecyl sulfate) changes should be routinely detectable in at least 20 proteins at once, facilitating studies of human mutation rates.

51104 Direct assignment of the cysteinyl, the slowly exchangeable, and the aromatic ring H nuclear magnetic resonances in clostridial-type ferredoxins. Packer, E.L. (Univ. of California, Berkeley); Sweeney, W.V.; Rabinowitz, J.C.; Sternlicht, H.; Shaw, E.N. *J. Biol. Chem.;* **252**: No. 7, 2245-2253(10 Apr 1977).

We have directly assigned the ^{1}H NMR corresponding to the cysteinyl protons, the slowly exchangeable protons, and the aromatic ring protons in the ^{1}H NMR spectrum of Clostridium acidi-urici ferredoxin by isotopic labeling and ^{13}C NMR decoupling techniques. We also show that the resonance pattern in the 8- to 20-ppM (from 2,2-dimethyl-2-sialapentanesulfonic acid) region of the ^{1}H NMR spectra of oxidized Clostridium acidi-urici, Clostridium pasteurianum, Clostridium perfringens, and Peptococcus aerogenes ferredoxins are very similar, and we assign the resonances in this region by analogy with the spectrum of C. acidi-urici ferredoxin. The ^{1}H NMR spectra of the β protons of the cysteinyl residues of these ferredoxins differ, however, from the ^{1}H NMR spectra of equivalent β protons of the methylene carbon atoms bonded via a sulfur atom to [4Fe-4S] clusters in synthetic inorganic analogues. In the spectra of the synthetic compounds, the β protons appear as a single resonance shifted 10 ppM from its unbonded reference position. In the spectra of oxidized clostridial ferredoxins, the cysteinyl β protons appear as a series of at least eight resolved resonances with shifts that range from 6 to 14 ppM, relative to the free amino acid resonance position.

51105 Developmental biochemistry of cottonseed embryogenesis and germination. VII. Free amino acid pool composition during cotyledon development. Capdevila, A.M.; Dure, L. III. (Univ of Georgia, Athens). *Plant Physiol.;* **59**: 268-273(1977).

The composition of the free amino acid pool in embryonic cotton (Gossypium hirsutum) cotyledons is quite distinct from that of endosperm, and that of germinated, greened cotyledons is quite distinct from that of leaves. During germination (including the precocious germination of immature seeds), the pool expands considerably showing a pronounced accumulation of asparagine. The high level of asparagine found in seedling roots and in the cotyledon vascular exudate indicates that this is the major transported amino acid in germination. There is no pool expansion in the presence of abscisic acid. In the presence of actinomycin D, the pool expands, but an enormous accumulation of glutamine takes place. The composition of the pool at any stage is not related to the composition of the isoacceptor transfer RNA pool, nor to the composition of the storage protein. Anaerobiosis leads to an accumulation of aspartate, alanine, and glycine at the expense of asparagine; however, desiccation does not result in an accumulation of proline. Conspicuously high levels of arginine are maintained through embryogenesis and germination. The levels of individual amino acids are presented as nanomol per cotyledon pair and as percent of total pool.

51106 Complementary specificity of restriction endonucleases of Diplococcus pneumoniae with respect to DNA methylation. Lacks, S.; Greenberg, B. (Brookhaven National Lab., Upton, NY). *J. Mol. Biol.;* **114**: 153-168(1977).

Restriction endonucleases Dpn I and Dpn II are produced by two distinct strains of Diplococcus pneumoniae. The two enzymes show complementary specificity with respect to methylation of sites in DNA. From the identity of its cleavage site with that of Mbo I, it appears that Dpn II cleaves at the unmodified sequence 5'-G-A-T-C-3'. Dpn I cleaves at the same sequence when the adenine residue is methylated. Both enzymes produce only double-strand breaks in susceptible DNA. Their susceptibility to Dpn I and not Dpn II shows that essentially all the G-A-T-C sequences are methylated in DNA from the pneumococcal strain that produces Dpn II as well as in DNA from Hemophilus influenzae and Escherichia coli. In the dam-3 mutant of E. coli none of these sequences appear to be methylated. Residual adenine methylation in the dam-3 mutant DNA most likely occurs at different sites. Different but characteristic degrees of methylation at G-A-T-C sites are found in the DNA of bacterial viruses grown in E. coli. DNAs from mammalian cells and viruses are not methylated at this sequence. Mitochondrial DNA from Paramecium aurelia is not methylated, but a small proportion of G-A-T-C sequences in the macronuclear DNA of this eukaryote appear to be methylated. Possible roles of sequence-specific methylation in the accommodation of plasmids, in the replication of DNA, in the regulation of gene function and in the restriction of viral infection are discussed.

51107 Additive evolutionary trees. Waterman, M.S. (Idaho State Univ., Pocatello); Smith, T.F.; Singh, M.; Beyer, W.A. *J. Theor. Biol.;* **64**: 199-213(1977).

Metric trees are dendrograms which show the phylogenetic relationships for a set of contemporary species. These dendrograms have numerical values attached to the branches. If the sum of these values on the branches between any two contemporary species is equal to the dissimilarity between these two species, the metric tree is said to be additive and possess an additive dissimilarity matrix. Metric trees and additive matrices are discussed and the uniqueness of the metric tree for an additive dissimilarity matrix is shown. A simple algorithm is given to generate the metric tree for an additive dissimilarity matrix. This algorithm is extended to nonadditive dissimilarity matrices through the use of linear programming. Finally, some results for cytochrome c sequences are presented.

51108 Lipid bilayer membrane as an assay for ion-conductance-inducing materials isolated from biological membranes. Blumenthal, R. (National Cancer Inst., Bethesda, MD); Shamoo, A.E. *Ann. N.Y. Acad. Sci.;* **264**: 483-485(30 Dec 1975).

A summary is given of a panel discussion concerning meaningful reconstitution of ion conductance from biological membranes. One of the prerequisites given is the use of purified material with a well-defined biochemical basis such as the acetylcholine receptor or sodium channels in nerve, or purified enzyme known to be associated with ion transport. The bilayer experiments should closely mimic the physiological response. Bulk phase experiments should complement bilayer measurements. Reproducibility and effect of the extracted protein on bilayer rupture should be reported. (MFB)

51109 Isolation of ionophores from ion-transport systems. Shamoo, A.E.; Ryan, T.E. (Univ. of Rochester, NY). *Ann. N.Y. Acad. Sci.;* **264**: 83-97(30 Dec 1975).

In the report evidence is presented for the characterization and isolation of variety of ionophores from various sources. Evidence is also presented for the following: (1) the characterization of Na^+-dependent ionophore from Na + K-ATPase; (2) the isolation of cation-selective ionophoric peptide fragment from Na^+ + K^+-ATPase; (3) the isolation of K^+-dependent ionophore from Na^+ + K^+-ATPase; (4) the demonstration that a cholinergic-agent-sensitive cation-selective ionophore is part of the acetylcholine receptor; (5) the isolation and characterization of Ca^{2+}-dependent ionophore as a peptide fragment (< 2,000 daltons) from sarcoplasmic reticulum Ca^{2+} + Mg^{2+}-ATPase.

51110 Origin of molecular handedness in living systems. Noyes, H.P.; Bonner, W.A. (Stanford Linear Accelerator Center, CA). *J. Mol. Evol.;* **6**: 91-98(1975).

Elementary-particle effects (β decay) provide at best only a weakly handed radiation in the biologically effective energy ranges. Global magnetic effects coupled to sunlight are randomized by paleomagnetic reversals. Hence a persistent terrestrial handed bias at possible local biopoetic sites offers a more promising explanation for the origin of the handedness of the molecules found among living systems on earth. Magnetite in lava flows maintains a handed bias for surface catalysis through many magnetic reversals. Magnetite contaminated with sulfur has already been proposed by Granick as a biopoetic site because it provides a weak source of chemical energy derived by photochemical conversion. Indirect evidence for this hypothesis has been provided by the molecular structure of ferrodoxin, a single strand of the 14 primordial amino acids wrapped around an FeS core. Lava flows have been suggested as biopoetic sites, since their temperature and chemical composition might allow for the rapid synthesis of prebiotic compounds at the surface of the primitive earth. The additional fact that magnetite in lava flows also provides a persistent handed site for surface catalysis offers a further argument for the experimental investigation of this specific biopoetic environment. 1 figure.

51111 Active sites of biological macromolecules and their interaction with heavy metals. Eichhorn, G.L. (National Institutes of Health, Baltimore). pp 123-142 of Ecological toxicology research. Effects of

heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

The following topics are discussed: metal ions and active sites; reaction of metal ions with sites other than the active site; activation vs inhibition; metal binding to nucleic acids; metal ions and crosslinking in polynucleotides; and cleavage of biomacromolecules by metal ions. (HLW)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 51117, 51147, 51151, 51211

CYTOLOGY

REFER ALSO TO CITATION(S) 51094, 51280

51112 (UCRL—80105) **Dispersal of solid tumors for flow cytometer (FCM) analysis.** Pallavicini, M.G.; Cohen, A.M.; Dethlefsen, L.A.; Gray, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Sep 1977. Contract W-7405-ENG-48. 22p. (CONF-770324—9). Dep. NTIS, PC A02/MF A01.

From 3. international conference on impulse cytophotometry; Vienna, Austria (30 Mar 1977).

Flow cytometer (FCM) analysis of the DNA content of solid tumors necessitates tumor dispersal into single cell suspensions. Single cell suspensions of S102F mammary tumors are prepared by incubating minced tumor tissue at 37°C in a sucrose-salt solution containing sodium tetraphenylboron (TPB), a potassium-complexing reagent. After one hour of incubation, the tumor pieces are passed several times through a plastic syringe to dissociate the remaining undispersed fragments. The cells are incubated for an additional 30 minutes and then filtered through 37 μm nylon mesh. The tumor cells are washed with saline and fixed in formalin for FCM analysis. Approximately 2 to 8 x 10^7 cells are obtained per 150 μl tumor volume. Histograms of the distribution of the DNA content of acriflavin-stained tumor cells show a minimal amount of background debris and cell clumping.

51113 Hydrodynamic orientation of sperm heads for flow cytometry. Dean, P.N.; Pinkel, D.; Mendelsohn, M.L. (Lawrence Livermore Lab., CA). *Biophys. J.;* **23**: No. 1, 7-13(Jul 1978).

Two specially shaped sample injection tubes orient flat-shaped mature sperm heads in a flow cytometer. Orientation allows control of a photometric difficulty experienced with some flow cytometers in the measurement of fluorescent and scattered light from sperm and other flat cells. Both relative DNA-stain content and a measure of cell flatness can now be determined simultaneously for each cell at the high rates possible with flow instruments.

51114 Temperature dependence of the survival of human erythrocytes frozen slowly in various concentrations of glycerol. Souzu, H.; Mazur, P. (Oak Ridge National Lab., TN). *Biophys. J.;* **23**: No. 1, 89-100(Jul 1978).

One widely accepted explanation of injury from slow freezing is that damage results when the concentration of electrolyte reaches a critical level in partly frozen solutions during freezing. We have conducted experiments on human red cells to further test this hypothesis. Cells were suspended in phosphate-buffered saline containing 0 to 3 M glycerol, held for 30 min at 20°C to permit solute permeation, and frozen at 0.5 or 1.7°C/min to various temperatures between -2 and -100°C. Upon reaching the desired minimum temperature, the samples were warmed at rates ranging from 1 to 550°C/min and the percent hemolysis was determined. The results for a cooling rate of 1.7°C/min indicate the following: (a) Between 0.5 and 1.85 M glycerol, the temperature yielding 50% hemolysis (LT_{50}) drops slowly from -18 to -35°C. (b) The LT_{50}'s over this range of concentrations are relatively independent of warming rate. (c) With glycerol concentrations of 1.95 and 2.0 M, the LT_{50} drops abruptly to -60°C and to below -100°C, respectively, and becomes dependent on warming rate. The LT_{50} is lower with slow warming at 1°C/min than with rapid. With still higher concentrations (2.5 and 3.0 M), there is no LT_{50}, i.e., more than 50% of the cells survive freezing to -100°C. Results for cooling at 0.5°C/min in 2 M glycerol were similar except that the LT_{50}'s were some 10 to 20°C higher. A companion paper (Rall et al., Biophys. J. 23: 101-120, 1978) examines the relation between survival and the concentrations of salts produced during freezing.

51115 Physical-chemical basis of the protection of slowly frozen human erythrocytes by glycerol. Rall, W.F.; Mazur, P.; Souzu, H. (Oak Ridge National Lab., TN). *Biophys. J.;* **23**: No. 1, 101-120(Jul 1978).

One theory of freezing damage suggests that slowly cooled cells are killed by being exposed to increasing concentrations of electrolytes as the suspending medium freezes. A corollary to this view is that protective additives such as glycerol protect cells by acting colligatively to reduce the electrolyte concentration at any subzero temperature. Recently published phase-diagram data for the ternary system glycerol-NaCl-water by M.L. Shepard et al. (Cryobiology, 13: 9-23, 1976), in combination with the data on human red cell survival vs. subzero temperature presented here and in the companion study of Souzu and Mazur (Biophys. J., 23: 89-100), permit a precise test of this theory. Appropriate liquidus phase-diagram information for the solutions used in the red cell freezing experiments was obtained by interpolation of liquidus data of Shepard and his co-workers. The results of phase-diagram analysis of red cell survival indicate that the correlation between the temperature that yields 50% hemolysis (LT_{50}) and the electrolyte concentration attained at that temperature in various concentrations of glycerol is poor. With increasing concentrations of glycerol, the cells were killed at progressively lower concentrations of NaCl. For example, the LT_{50} for cells frozen in the absence of glycerol corresponds to a NaCl concentration of 12 weight percent (2.4 molal), while for cells frozen in 1.75 M glycerol in buffered saline the LT_{50} corresponds to 3.0 weight percent NaCl (1.3 molal). The data, in combination with other findings, lead to two conclusions: (a) The protection from glycerol is due to its colligative ability to reduce the concentration of sodium chloride in the external medium, but (b) the protection is less than that expected from colligative effects; apparently glycerol itself can also be a source of damage, probably because it renders the red cells susceptible to osmotic shock during thawing.

51116 Comparative study of the pretumorous thyroid gland of the gynogenetic teleost, Poecilia formosa, and that of other poeciliid fishes. Woodhead, A.D.; Scully, P.M. (Brookhaven National Lab., Upton, NY). *Cancer Res.;* **37**: 3751-3755(Oct 1977).

A laboratory clone of the gynogenetic fish, Poecilia formosa (the Amazon molly), showed a high incidence of invasive thyroid hyperplasia when injected with isogenic fish cells with damaged DNA. The sensitivity of the response indicated that the thyroid gland of this species might differ from that typically found in fish. Comparisons were made between the thyroid of P. formosa of several ages and that of five closely related species that had been kept under the same laboratory conditions. In the five related species, the thyroid gland was composed of a few, uniform, colloid-filled follicles lined with cuboidal epithelial cells, scattered around the ventral aorta. The thyroid gland of P. formosa was more extensive and, in addition to normal follicles, contained areas of microfollicles and afollicular groups of epithelial cells. The follicular cells were hypertrophied and, in some areas of the gland, there was hyperplasia of the connective tissue. There was an increase in the abundance of these atypical elements with advancing age. The appearance of the thyroid gland of P. formosa resembled that seen in the stages of development of thyroid tumors in some highly inbred strains of fish. Young Amazon mollies appear to have a high probability of developing invasive thyroid hyperplasia under the influence of cells with damaged DNA, yet in young fish the response is quite precise and specific. P. formosa seems to provide good advantages as a test animal for oncogenic studies.

51117 Separation of muscle and non-muscle cells from adult rat myocardium: an application to the study of RNA polymerase. Cutilletta, A.F.; Aumont, M.C.; Nag, A.C.; Zak, R. (Univ. of Chicago). *J. Mol. Cell. Cardiol.;* **9**: 399-407(1977).

Non-muscle cells, closely adherent to myocytes, can be demonstrated by nuclear staining techniques in isolated myocardial cells. The method for isolating myocardial muscle and non-muscle cells that we have described significantly reduces cross-contamination. This procedure makes it possible, for the first time, to measure RNA synthesis, as nuclear RNA polymerase activity, in separated muscle and non-muscle cells. Biochemical reactions can now be studied simultaneously in two entirely different cell types from the same organ under similar conditions.

51118 (LA-tr—78-38) **Nile blue (sulfate) as lipophilic fluorochrome and redox indicator.** Holzl, J.; Bancher, E. Translated from *Mikroskopie;* **24**: 29-40(1969). 18p. Dep. NTIS, PC A02/MF A01.

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A diffuse brown red plasma fluorescence may be obtained with Nile blue sulfate on Allium cepa epidermis by action of dye base, or a reddish fluorescence of the spherosomes both in living and dead cells, and at last a bright yellow spherosome fluorescence after biogenic reduction caused by airtight covering with cover glass. The higher polarity of the dye base may be responsible for such event. The onion epidermis reduces the Nile blue according to the physiological conditions and respiratory power. Epidermis and mesophyll of Aucuba japonica need one or two days for reduction, likewise the arillus cells of Euonymus europaea and the coconut endosperm with high lipid content. Contamination in bacteria results in perfect reduction to leuco-form. The very strong fluorescence of Nile blue's

lipophilic leuco-form makes this stain appear most suitable as redox indicator or as medium for measurements of respiratory intensities of higher plant cells and tissues.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 51117, 51147, 51151, 51206

GENETICS

REFER ALSO TO CITATION(S) 51098, 51103, 51141, 51170, 51245

51119 (BNL—24326) **Mechanism of post-replication repair in mammalian cells.** Doniger, J. (Brookhaven National Lab., Upton, N.Y. (USA); National Cancer Inst., Bethesda, Md. (USA)). 1978. Contract EY-76-C-02-0016. 4p. (CONF-780226—10). Dep. NTIS, PC A02/MF A01.

From Symposium on DNA repair mechanisms; Keystone, CO, USA (19 Feb 1978).

Two mechanisms proposed to explain post-replication repair of DNA strand breaks in mammalian cells are discussed. The gapped synthesis model predicts that daughter strands replicated on damaged templates will contain discontinuities. The size of the nascent strands should be equal to the distance between the damages. Moreover, the rate of fork movement should be independent of the rate of discontinuity repair. The replicative bypass model predicts that there will be no discontinuities in the daughter strands. Blocking repair would prevent fork movement. The experiments reported using cultured Chinese hamster cells were performed in order to distinguish between these two mechanisms.

51120 (ORAU/IEA—78-2(R), pp 37-55) **Evolution of resistance to environmental agents.** Waters, R. (Oak Ridge National Lab., TN). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: stability and flexibility of DNA as requirements for survival and evolution of unicellular organisms; methods of increasing DNA content in lower and higher organisms, duplication of bacterial genes by transduction; homologous unequal crossing-over; replication, repair, and mutation of DNA; and excision repair of DNA. (HLW)

51121 (ORAU/IEA—78-2(R), pp 56-75) **Introduction to quantitative genetic concepts.** Sing, C.F. (Univ. of Michigan, Ann Arbor). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: role of variability of multiple environmental factors in determining individual's phenotype; polygenes determining quantitative traits; effect of environmental input on contribution of polygenes; use of biochemistry in studies on genotype-phenotype links; biological model for quantitative trait; statistical model for analysis of quantitative variability; and statistical analysis to determine the contributions of hemoglobin, glucose-6-phosphate, and ADP to the physiological and genetic determination of the quantitative variability among individuals in erythrocyte ATP. (HLW)

51122 Founder effect and number of private polymorphisms observed in Amerindian tribes. Neel, J.V.; Thompson, E.A. (Univ. of Michigan Medical School, Ann Arbor). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 4, 1904-1908(Apr 1978).

In studies extending over the past dozen years, we have observed eight examples of private genetic polymorphisms in 12 Amerindian tribes surveyed for electrophoretic variants of an average of 25 proteins. Each of these is presumed to trace to a single mutation. In a preceding communication [Thompson, E.A. and Neel, J.V. (1978) Proc. Natl. Acad. Sci. USA 75, 1442-1445] the statistical theory was developed for estimating the likelihood of such a founder effect in a tribal population of this type. In this paper that theory is applied to the distribution defined by these eight variants. It is demonstrated that on the assumption that the phenotypes in question are selectively neutral, such findings are most compatible with a mutation rate of 7 x 10-^{6}/locus per generation. This figure applies only to variants that can be detected by the electrophoretic technique.

51123 Theoretical population genetics of variable selection and migration. Felsenstein, J. (Univ. of Washington, Seattle). *Annu. Rev. Genet.;* **10**: 253-280(1976).

Selection varying with time is reviewed with regard to infinite and finite populations. Geographic effects are reviewed with regard to migration versus selection; genetic drift and migration; and selection. Various models of geographic differentiation are described. (HLW)

METABOLISM

REFER ALSO TO CITATION(S) 51015, 51063, 51100, 51278, 51282, 51288, 51289, 51291, 51295

51124 Effect of vitamin or amino acid supplementation on plasma free amino acid levels in South African blacks. Hankes, L.V. (Brookhaven National Lab., Upton, NY); Jansen, C.R. *S. Afr. Med. J.;* **52**: 110-114(16 Jul 1977).

The object of this study was to determine the effect of large oral doses of L-leucine, vitamin B_1, vitamin B_2, vitamin B_6 or vitamin C, given over a period of days, on the plasma free amino acid levels and protein nutrition index values of South African Blacks on a maize diet. In addition, single loads of L-tryptophan or L-kynurenine were given before and after the above regimen of L-leucine or vitamin to determine the effect of tryptophan or kynurenine with and without the influence of these factors on the plasma free amino acid levels and protein nutrition index values. Vitamin C therapy or a single dose of L-tryptophan increased the total plasma free amino acid levels. L-leucine therapy or a single loading dose of L-tryptophan increased the protein nutrition index. Single loading doses of L-kynurenine decreased the protein nutrition index. The levels of non-essential amino acids in the plasma of Blacks were much higher than those of Whites, and consequently the protein nutrition index values were much lower.

51125 Reactive metabolities of organohalogen compounds. Gillette, J.R. (National Heart and Lung Inst., Bethesda, MD). pp 107-122 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

Studies with several halogenated benzenes and other foreign compounds indicate that severe toxicities such as liver necrosis may occur only when a threshold dose is exceeded. At low doses, these foreign compounds may be innocuous but at high doses they may cause serious toxicities. At high doses either a greater proportion of the dose is converted to a reactive metabolite or a greater proportion of the reactive metabolite combines with tissue components and thereby causes the toxicity. Which of these situations predominates may be influenced by prior administration of inducers or inhibitors of drug-metabolizing enzymes. The effects of the pretreatment may depend on the dose. At low doses of bromobenzene, phenobarbital pretreatment decreases the covalent binding of the reactive metabolites, whereas at high doses the pretreatment increases the covalent binding of the reactive metabolite. Thus, any toxicity that is caused by low levels of the reactive metabolite would be decreased by pretreatment of animals after low doses of the toxicants are administered, but would be increased after high doses are given. The administration of certain inducers may affect the severity of toxicities by altering the proportion of the toxicant that is converted to reactive metabolites. Thus, the pretreatment of animals with 3-methylcholanthrene decreases the proportion of bromobenzene that is converted to bromobenzene-3,4-epoxide and thereby decreases its covalent binding and toxicity. Even though enzyme systems that form reactive metabolites are present in extrahepatic tissues, it cannot be automatically assumed that all of the reactive metabolite that reacts with components of extrahepatic tissues is formed in those tissues. However, when a major portion of the covalently bound reactive metabolite in extrahepatic tissues is produced in those tissues, various treatments may decrease toxicities in some tissues but enhance them in others.

51126 Uptake, fate, and action of heavy metals and organohalogen compounds in living organisms. pp 257-283 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

The uptake and fate of metals and organohalogen compounds are discussed with regard to entry into living organisms, biotransformation, tissue distribution, retention, excretion, and recommendations. The toxic action of metals is discussed with regard to criteria for selection of species for study of adverse effects, toxic effects at various levels of biological organization, and categories of metals.

The toxic effects of organohalogen compounds are discussed with emphasis on the nervous system. Factors influencing toxicity are as follows: species, stress, age, sex, synergism, and genetic differences. A summary of recommendations for future study is presented. (HLW)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 51269, 51278

MEDICINE

REFER ALSO TO CITATION(S) 50787, 51130, 51139, 51140, 51193, 51288, 51290, 51291

51127 Organ distribution of technetium-99m-labeled Corynebacterium parvum in normal and tumor-bearing mice. Barth, R.F.; Singla, O. (Univ. of Kansas, Kansas City). *Cancer Res.;* **38**: No. 1, 32-37(Jan 1978).

The distribution patterns were studied for /sup 99m/Tc-labeled Corynebacterium parvum in normal and tumor-bearing mice. C57BL/6 mice were given i.v., i.p., or s.c. injections of 250 μg of /sup 99m/Tc-labeled C. parvum and killed at 10 min, 1, 4, and 24 hr. After iv. administration, labeled organisms were distributed primarily to the liver, the lungs, and the blood (46% of injected dose), followed by the gastrointestinal tract, the spleen, and the kidneys (11%). Total recoverable radioactivity, which was defined as the percentage of injected dose that was recovered, ranged from 59% at 10 min to 15% at 24 hr. In contrast to this, /sup 99m/TcS colloid, an inert particulate material, was localized almost entirely in the liver, and the amount recoverable remained constant over 24 hr. One hr after i.p. administration of /sup 99m/Tc-labeled C. parvum, the gastrointestinal tract accounted for 27% of the injected radioactivity, followed by liver, blood, and spleen (12%). This was rapidly excreted between 4 and 24 hr, at which time only 12% of the injected dose was recovered. The skin accounted for 54.6% of the injected radioactivity 1 hr after s.c. injection, 6% 4 hr after s.c. injection, and 0.8% at 24 hr after s.c. injection.

51128 Heavy metal pollution among autoworkers. I. Lead. Clausen, J.; Rastogi, S.C. (Odense Univ., Denmark). *Br. J. Ind. Med.;* **34**: No. 3, 208-215(Aug 1977).

Lead pollution was evaluated in 216 individuals working in 10 garages on the Island of Funen, Denmark and related to data from biochemical and medical examinations. Clinical symptoms were recorded by means of a questionnaire. Increased blood lead levels were found in 59 percent, with 9 percent having above 80 μg lead/100 ml (3.86 μmol/l) whole blood. Mechanics in eight out of ten garages had significantly increased blood lead levels. A decrease in delta-aminolevulinic acid dehydratase (ALAD) activity was associated with increased blood lead levels but the latter were not related to hematological changes, tobacco consumption or to length of service in the trade. Particulate lead air pollution was not the sole cause of increased blood lead levels. Raised lead values were maximal among diesel engine workers who are exposed to high pressure-resistant lubricants containing lead naphthenate. As these workers complained of skin damage, lead absorption may have occurred through the skin. Assay of lead content showed 9290 ppm in gear oil and 1500-3500 ppm in used motor oils. The data are discussed in relation to the occupational risks in auto repair shops.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 51127, 51144, 51288

51129 (UCLA—12-1157) **Regional myocardial perfusion assessed by N-13 labeled ammonia and positron emission computerized axial tomography.** Schelbert, H.R.; Phelps, M.E.; Hoffman, E.J.; Huang, S.C.; Selin, C.E.; Kuhl, D.E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1978. Contract EY-76-C-03-0012. 39p. Dep. NTIS, PC A03/MF A01.

The usefulness of $^{13}NH_3$ as an indicator of regional myocardial perfusion suitable for positron emission computerized axial tomography (PCT) has been suggested. However, the relationship between myocardial blood flow and uptake of $^{13}NH_3$ has not been examined quantitatively. It was therefore the purpose of the current investigation to quantitate the relationship of myocardial $^{13}NH_3$ tissue concentration to myocardial blood flow and to examine its suitability for PCT imaging. Twelve open chest dogs were studied. In 8 of the dogs 25 imaging procedures with $^{13}NH_3$ and PCT were performed. In the remaining four dogs the relationship between flow and myocardial $^{13}NH_3$ tissue concentration was assessed by in vitro techniques. The PCT technique provided high quality cross-sectional images of the distribution of $^{13}NH_3$ in left ventricular myocardium. No significant redistribution of $^{13}NH_3$ in myocardium occurred with time. Alterations in regional myocardial blood flow resulted in changes of the regional distribution of $^{13}NH_3$ that were readily appreciated on the PCT images.

51130 Non-Hodgkin's lymphoma, poorly differentiated lymphocytic and mixed cell types. Results of sequential staging procedures, response to therapy, and survival of 100 patients. Bitran, J.D.; Golomb, H.M.; Ultmann, J.E. (Univ. of Chicago). *Cancer;* **42**: No. 1, 88-95(Jul 1978).

The results of sequential staging procedures including laparotomy, radiotherapy, and combination chemotherapy are reported for 100 patients with poorly differentiated lymphocytic (PDL) and mixed cell (MC) non-Hodgkin's lymphoma (NHL). Twelve patients were found to have localized disease, pathologic stage (PS) I or II; 88 patients had PS III or IV disease. Bone marrow biopsy showed a high incidence of involvement and advanced 34% of the patients from PS I, II, and III to PS IV. Staging laparotomy has a very limited role in the evaluation of these patients. All of 12 patients with PS I and II NHL were treated with radiotherapy; at 5 years, they had 100% survival, 80% being disease-free. Fifteen patients with PS III disease were treated with total nodal radiotherapy (TNRT) alone and had a median disease-free survival of 41 months. The remaining patients with PS III and IV disease were treated with chemotherapy consisting of vincristine and prednisone (V and P); cyclophosphamide, vincristine (Oncovin), procarbazine, and prednisone (COPP); cyclophosphamide, vincristine (Oncovin), adriamycin, and prednisone (COPA); or palliative therapy consisting of chlorambucil and prednisone. Two-year and 4-year survivals for patients with diffuse lymphoma were 93% and 60%, respectively; for patients with +2 nodular lymphoma, 80% and 30%; and for patients with nodular lymphomas, 76 to 93% and 50%, respectively. Treatment with COPP showed no advantage over V and P, palliative therapy, or TNRT for patients with +2 nodular and nodular disease. The likelihood of cure appears most promising for patients in complete remission (CR) with diffuse lymphoma; patients in CR with nodular lymphoma show a high rate of relapse over 5 years of observation. We conclude that staging laparotomy in PDL and MC NHL is of limited value, and that the role of aggressive chemotherapy for patients with +2 nodular and nodular lymphoma needs to be redefined.

51131 Prenatal multicarcinogenesis by ethylnitrosourea in mice. Vesselinovitch, S.D.; Koka, M.; Rao, K.V.N.; Mihailovich, N.; Rice, J.M. (Univ. of Chicago). *Cancer Res.;* **37**: 1822-1828(Jun 1977).

The role of prenatal age, sex, and the maternal background upon the incidence, multiplicity, and spectrum of tumors induced by ethylnitrosourea has been studied in the offspring of reciprocal hybrids of the same genotype. The first generation (F_1) offspring of C57BL/6J x C3HeB/FeJ and the reciprocal hybrids were observed throughout their life-span for tumor development following single i.p. injections of ethylnitrosourea (60 μg/g) given to pregnant mothers at 12, 14, 16, or 18 days of gestation. Animals exposed to ethylnitrosourea survived on the average for only 90 weeks. They developed by that age tumors in lungs, livers, ovaries, nervous system, and forestomach. Control mice killed at 90 weeks were essentially free of tumors. The fetal age at the time of adminstration of the carcinogen was one of the most significant modulators of tumor development in lung, liver, ovaries, and nervous system. The sex of the animals influenced the rate of development of liver tumors, whereas material background affected the multiplicity of lung tumors.

51132 Value of cerebral scintiscanning with /sup 99m/Tc pertechnetate. Comparative evaluation of neuroradiological diagnosis (statistical study). Contini, C.; Bertolino, G.C.; Calbiani, B.; Ugolotti, G. (Univ., Parma, Italy). *Ateneo Parmense, Sez. I;* **48**: No. 1, 33-39(1977). (In Italian).

Authors have analyzed the efficacy of brain scanning detecting in neurological diseases and compare this examination with usual neuro-radiological screenings. They have noted an absolute diagnostic accuracy (100%) in various cases of vascular diseases and a great accuracy (81.8%) in cases of brain tumors.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 49436, 51012, 51054, 51099, 51101, 51127, 51172

51133 Methodologies for the determination of adenosine phosphates. Bostick, W.D.; Ausmus, B.S. (Oak Ridge National Lab., TN). *Anal. Biochem.;* **88**: No. 1, 78-92(15 Jul 1978).

Measures of adenosine trichosphate (ATP) and other adenosine phosphate compounds are useful indices of microbial biomass and microbiological activity. Various photometric procedures for the determination of these compounds are compared. A modification in the well-known hexokinase—glucose-6-phosphate dehydrogenase

procedure for ATP, which permits a very sensitive kinetic measurement of ATP + ADP (approximately 3.1 pmole), is presented. The procedure utilizes phosphoenol pyruvate and pyruvate kinase to regenerate ATP (substrate in the preceding reaction) and thus is an amplification system. Longer reaction times and fluorimetric measurement of NADPH produced would further enhance the sensitivity of the procedure. Finally, a simple, rapid far-uv spectrophotometric procedure, previously believed to be specific for adenosine monophosphates, is demonstrated to provide quantitative estimates for adenosine diphosphate (ADP) and ATP as well.

51134 Enumeration of petroleum-degrading marine and estuarine microorganisms by the most probable number method. Mills, A.L.; Breuil, C.; Colwell, R.R. (Univ. of Maryland, College Park). *Can. J. Microbiol.;* **24**: No. 5, 552-557(May 1978).

Several media designed for use in a most probable number (MPN) determination of petroleum-degrading microorganisms were compared. The best results, i.e., largest numbers, were obtained using a buffered (32 mM PO_4^{-3}) liquid medium containing 1 percent hydrocarbon substrate. Of 104 presumptive oil degraders tested, 20 grew on oil agar medium but did not utilize oil or a mixture of pure paraffinic hydrocarbons (C_{10} to C_{16} n-alkanes) in liquid (MPN) medium. Visible turbidity in the liquid medium was correlated with hydrocarbon utilization. Counts of petroleum degraders obtained using liquid medium (MPN) were in most cases higher than those obtained on an oil-amended silica gel medium. Both procedures yield an estimation of oil degraders, and the oil-amended agar permits growth of organisms which do not degrade crude oil. All strains of oil-degrading microorganisms examined in this study were lipolytic, but the converse was not always true.

51135 Effects of temperature on growth of four high Arctic soil fungi in a three-phase system. Widden, P. (Concordia Univ., Montreal); Parkinson, D. *Can. J. Microbiol.;* **24**: No. 4, 415-421(Apr 1978).

The effect of temperature on the growth of Chrysosporium pannorum, Cylindrocarpon sp., Penicillium janthinellum, and Phoma herbarum, isolated from tundra soils, was studied. The growth in two systems, glucose-mineral agar plates and sand, moistened with glucose-mineral broth, was compared. All isolates showed an exponential increase in mass (measured as protein increase) in sand and a linear rate of extension on agar. Radial increase on agar was shown not to be a good index of growth in sand. Trends in growth rates in the sand cultures indicated that all four fungi can grow at low temperatures. The growth rate for Penicillium janthinellum at 15°C was higher than at 20°C, and Cylindrocarpon sp. and Phoma herbarum had higher growth rates at 2.5°C than at 5°C. These data suggest that there may be some adaptation by these fungi to growth in Arctic regions.

51136 Effects of heavy metals and other trace elements on the fermentative activity of the rumen microflora and growth of functionally important rumen bacteria. Forsberg, C.W. (Univ. of Guelph, Ont.). *Can. J. Microbiol.;* **24**: No. 3, 298-306(Mar 1978).

The inhibitory effects of high concentrations of essential and non-essential trace elements were tested on the rumen microflora using the rate of fermentation in vitro as the assay. The elements (and the concentration causing 50% inhibition) in decreasing order of toxicity were Hg^{2+} (20 μg/ml), Cu^{2+} (21 μg/ml), Cr^{6+} (70 μg/ml), Se^{4+} (73 μg/ml), Ni^{2+} (160 μg/ml), Cd^{2+} (175 μg/ml), As^{3+} (304 μg/ml), and As^{5+} (1610 μg/ml). The elements tested that were either weak or noninhibitory at concentrations greater than 400 μg/ml included Zn^{2+}, Cr^{2+}, Fe^{2+}, Mn^{2+}, Pb^{2+}, and Co^{2+}. Methylmercury was as inhibitory as mercuric chloride to the fermentation. When the inhibitory effect of Cd^{2+} was tested on separated bacterial and protozoal fractions, it was more inhibitory to the bacteria. The inhibitory effects of trace elements were also determined for a number of axenic cultures of rumen bacteria. The bacteria which most frequently exhibited the greatest sensitivity were Bacteroides succinogenes, Ruminococcus albus, Bacteroides amylophilus, and Eubacterium ruminantium. Those often exhibiting intermediate sensitivities included Butyrivibrio fibrisolvens, Selenomonas ruminantium, and Megasphera elsdenii, while Streptococcus bovis was very refractory to all elements tested. Rumen fluid provided a modest protective effect for the bacteria.

51137 Ecological study of bacteriophages of Vibrio natriegens. Zachary, A. (Virginia Inst. of Marine Science, Gloucester Point). *Can. J. Microbiol.;* **24**: No. 3, 231-324(Mar 1978).

Effects of temperature and anaerobic conditions on the replication of two bacteriophages, nt-1 and nt-6, of the estuarine bacterium Vibrio natriegens were studied. Reduction in temperature resulted in longer latent periods and reduced burst sizes for both phages. Replication under anaerobic conditions resulted in longer latent periods; however, phage nt-6 had a reduced burst size, whereas phage nt-1 had an increased burst size, resulting in a rate of phage production nearly equal to that observed under aerobic conditions. Therefore the distribution of the phages in marsh areas could be influenced by temperature and anaerobiosis.

51138 Effects of 2-deoxyglucose, clucosamine, and mannose on cell fusion and the glycoproteins of herpes simplex virus. Knowles, R.W.; Person, S. (Pennsylvania State Univ., University Park). *J. Virol.;* **18**: No. 2, 644-651(May 1976).

2-Deoxyglucose and glucosamine were found to inhibit cell fusion caused by a syncytial mutant of herpes simplex virus and to inhibit the glycosylation of viral glycoproteins in the infected cells. The inhibition of fusion and the inhibition of glycosylation caused by 2-deoxyglucose were substantially prevented when mannose was also present during infection. When glycosylation was inhibited, three new bands were found in the major glycoprotein region on sodium dodecyl sulfate-polyacrylamide gels. These bands may be precursors to the normal glycoproteins. The correlation between fusion and glycosylation in the presence of 2-deoxyglucose, glucosamine, and mannose suggests that the cells cannot fuse if their glycoproteins have a considerably reduced carbohydrate content.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 51138, 51154

PATHOLOGY

REFER ALSO TO CITATION(S) 51114, 51115, 51127, 51156, 51247, 51277, 51280, 51281

51139 Development of a system for controlled release of benzo(a)pyrene, 7,12-dimethylbenz(a)anthracene, and phorbol ester for tumor induction in heterotopic tracheal grafts. Pal, B.C.; Topping, D.C.; Griesemer, R.A.; Nelson, F.R.; Nettesheim, P. (Oak Ridge National Lab., TN). *Cancer Res.;* **38**: No. 5, 1376-1383(May 1978).

The utility of the tracheal transplant model as a tool in in vivo carcinogenesis studies depends largely on the development of a good drug delivery system affording reproducible, sustained carcinogen release. Previously used methods have proven to be less than satisfactory. We studied the release of benzo(a)pyrene, 7,12-dimethylbenz(a)anthracene, and 12-O-tetradecanoylphorbol-13-acetate from pellets of varying composition. In vitro release of the two polycyclic hydrocarbons (PCH) from beeswax pellets showed little variability, regardless of PCH concentration. In marked contrast, in vivo release was highly variable, particularly at high PCH concentrations. This suggested that the in vivo variability was largely due to the toxic alterations of tissues, caused by carcinogen released at high rates. Pellets composed of beeswax:cholesterol in ratios of 1:1 to 1:9 showed markedly reduced rates of PCH release. At a ratio of 1:9, the overall release rate of benzo(a)pyrene was approximately 1 μg/day compared to approximately 7 μg/day for pellets with a pure beeswax matrix [100 μg benzo(a)pyrene pellets]. The variability of PCH release was simultaneously diminished, supporting the suspicion that it was a result of toxic tissue changes. Similarly reduced release rates could be obtained by adsorbing the PCH to charcoal particles. Studies with the promotor 12-O-tetradecanoylphorbol-13-acetate showed a release rate of 1.6 μg/day from pure beeswax (100 μg 12-O-tetradecanoylphorbol-13-acetate per pellet). This rate may have to be diminished before promotion studies in the tracheal transplant model can be attempted. Our studies demonstrate that protracted PCH release from pellets can be achieved by using a beeswax: cholesterol matrix instead of a pure beeswax matrix or by adsorbing the PCH to charcoal particles.

51140 Metabolism of benzo(a)pyrene and (-)-trans-7,8-dihydroxy-7,8-dihydrobenzo(a)pyrene by rat liver nuclei and microsomes. Pezzuto, J.M.; Yang, C.S.; Yang, S.K.; McCourt, D.W.; Gelboin, H.V. (New Jersey Medical School, Newark). *Cancer Res.;* **38**: No. 5, 1241-1245(May 1978).

The metabolism of benzo(a)pyrene and (-)-trans-7,8-dihydroxy-7,8-dihydrobenzo(a)pyrene was examined by high-pressure liquid chromatography. Liver nuclei or microsomes from control, 3-methylcholanthrene-treated, or phenobarbital-treated rats were used. An improved method of separating the metabolites is described. Upon treatment with 3-methylcholanthrene, metabolism of benzo(a)pyrene was enhanced 4- and 9-fold in microsomes and nuclei, respectively. No enhancement was observed with phenobarbital treatment. The pattern of metabolites obtained with nuclei was similar to that of the corresponding microsomes, although quantitatively reduced. Nuclei and microsomes also metabolized (-)-trans--7,8-dihydroxy-7,8-dihydrobenzo(a)pyrene to 7,8-diol-9,10-epoxides and again the metabolic pattern was similar. Each of the nuclear samples produced less diol-epoxides than did the corresponding microsomes. Treatment with 3-methylcholanthrene caused an 8-fold increase in r-7, t-8-dihydroxy-t-9, 10-oxy-7,8,9,10-tetrahydrobenzo(a)pyrene (diol-epoxide I) formation with microsomes but only a 2-fold increase with nuclei. Inducible, r-7, t-8-dihydroxy-c-9, 10-oxy-7,8,9,10-tetrahydrobenzo(a)pyrene (diol-epoxide II) formation was also detected. Phenobarbital treatment did not

greatly increase diol-epoxide formation. Since both the microsomes and the nuclei can produce diol-epoxides, both organelles may be considered as potentially important sites of carcinogen activation.

51141 Mapping of human chromosomal regions related to neoplasia: evidence from chromosomes 1 and 17. Rowley, J.D. (Univ. of Chicago). *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 12, 5729-5733(Dec 1977).

In clonal aberrations leading to an excess or partial excess of chromosome I, trisomy for bands 1q25-1q32 was noted in the myeloid cells from all of 34 patients who had various disorders such as acute leukemia, polycythemia vera, and myelofibrosis. This was not the result of a particularly fragile site in that region of the chromosome because the break points in reciprocal translocations that involve it occurred almost exclusively in the short arm. Two consistent rearrangements that have been observed in chromosome 17 produced either duplication of the entire long arm or a translocation of the distal portion of the long arm to chromosome 15. The nonrandom chromosomal changes found in hematologic disorders can now be correlated with the gene loci on these chromosomes or chromosomal segments. Seventy-five genes related to various metabolic enzymes have been mapped; it may be significant that chromosomes carrying gene loci related to nucleic acid metabolism are more frequently involved in hematologic disorders (and other malignancies as well) than are gene loci related to intermediary or carbohydrate metabolism. Furthermore, the known virus-human chromosome associations are closely correlated with the chromosomes affected in hematologic disorders. If one of the effects of carcinogens (including viruses) is to activate genes that regulate host cell DNA synthesis, and if translocations or duplications of specific chromosomal segments produce the same effect, then either of these mechanisms might provide the affected cell with a proliferative advantage.

51142 Changes in liver composition in phenobarbital-induced hepatomegaly. Shenoy, S.T.; Peraino, C. (Argonne National Lab., IL). *Exp. Mol. Pathol.;* **27**: No. 1, 134-141(Aug 1977).

In a study of molecular events occuring during phenobarbital-induced hepatomegaly, the levels of poly(A)-RNA (heterogeneous nuclear RNA + cytoplasmic mRNA), total RNA, DNA, and protein were compared in untreated rats and those injected with phenobarbital (80 mg/kg/day) for 3 days. Total poly(A)-RNA isolated by phenol extraction and purified by affinity chromatography on oligo(dT)-cellulose, was assayed for its template (messenger RNA) activity in a cell-free protein synthetic system derived from wheat germ. The cell-free system was sufficiently sensitive to detect differences of less than a microgram of mRNA when optimal concentrations of Mg^{2+} and K^{+} were used. Using this system, no significant differences in the hepatic content of poly(A)-RNA were observed between the control and treated groups. The DNA level was also unchanged, but the liver weight was increased by 26% in the treated group. Total RNA and protein levels also increased significantly (25 and 38%, respectively, per 100 g body weight, and 21 and 30%, respectively per unit of DNA) in the treated group. Protein levels, when expressed in terms of poly(A)-RNA, showed a significant (22%) increase in the treated group. These results suggest that phenobarbital-induced hepatomegaly: (i) is characterized by hypertrophy (cell enlargement), (ii) is not mediated by a generalized increase in the level of poly(A)-RNA, but involves a generalized increase in the synthesis and-or stabilization of RNA other than functional message, and (iii) involves an increased translation of mRNA in vivo.

51143 Development of thyroid neoplasia in old age in the Amazon molly, Poecilia formosa. Woodhead, A.D. (Brookhaven National Lab., Upton, NY); Setlow, R.B.; Hart, R.W. *Exp. Gerontol.;* **12**: 193-200(1977).

In a previous paper we have described the appearance of a thyrotrophin sensitive thyroid neoplasm in a few senile individuals from a laboratory population of guppies, Lebistes reticulatus (Peters). Material has now been examined from the closely related species, Poecilia formosa, the Amazon molly, in which the incidence of thyroid neoplasms in the senile fish of our clones approaches 100 percent. The spontaneous growth seen in the old mollies was large, occupying much of the pharyngeal region. It was formed of three zones; at the center were inactive follicles with flattened epithelial cells enclosing a dense uneroded colloid. Peripherally, there was an area which microfollicles predominated, and the follicular epithelial cells frequently were swollen and balloon-like. The outermost area of the growth contained many afollicular groups of epithelial cells, lying amongst a great deal of loose connective tissue. The thyroid tissue was invasive, destroying muscle and bone. We have suggested that the spontaneous thyroid neoplasia in old P. formosa and L. reticulatus arise in a similar way. They develop as a result of the inability of the aging thyroid to respond to thyrotrophic hormone. Under continued pituitary stimulation the thyroid cells greatly proliferate and hypertrophy, and form a neoplasia. The appearance is described of massive thyroid growths which were experimentally induced by the injection into young mollies of cells with damaged DNA. There were striking differences between the induced and the spontaneous thyroid growths. The neoplasia of old fish was highly variable in structure, but the induced neoplasia had a regular appearance. Neoplastic tissue closely resembled normal thyroid tissue--but the growth was exuberant and highly invasive. We suggest that the differences between the neoplasm of old age and the induced neoplasm may reflect a different hormonal status.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 51156

51144 Microvascularization and permeability of histohematic barriers of Guerin's carcinoma during growth thereof and with administration of thio-tepa. Khananaev, L.I.; Fitsich, S.A. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 133-137(1978).

Translated from Radiobiologiya; 18: No. 1, 107-110(1978).

We made a study of permeability of histohematic barriers of Guerin's carcinoma using the radioisotope method in order to gain a fuller idea about the functional state of the vascular system of this tumor.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 51114, 51115, 51205, 51209, 51244, 51297

51145 (ORAU/IEA—78-2(R), pp 208-216) **Practical aspects of the immune response under natural circumstances.** Kennel, S. (Oak Ridge National Lab., TN). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: mechanisms of tumor rejection; effects of radiation and cytotoxic agents on immunosuppression; immunosurveillance of patients who have received organ transplants; immune reactions of tumors; sources of antigens; and methods of producing surface antigens. (HLW)

51146 Inhibition of erythropoietin production in unanesthetized rabbits exposed to an acute hypoxic-hypercapnic environment. Wolf-Priessnitz, J.; Schooley, J.C.; Mahlmann, L.J. (Univ. of California, Berkeley). *Blood;* **52**: No. 1, 153-162(Jul 1978).

Major factors affecting changes in the arterial Hb—O_2 affinity (P_{50}) were examined in relation to the initiation of erythropoietin (ESF) production in unanesthetized New Zealand white male rabbits. They were exposed to an isobaric hypoxic environment (8.8% O_2) with and without CO_2 (5.6% or 10%). During 5 hr exposure samples of arterial blood were collected for measurements of (1) plasma ESF titers, (2) whole blood pH, P/sub O_2/, P/sub CO_2/, S/sub O_2/, lactate, pyruvate, and P_{50}, and (3) intraerythrocytic 2,3—DPG, ATP, and ADP. Exposure to 8.8% O_2 alone stimulated ESF production and caused a leftward shift in the P_{50} in vivo (P/sub 50(i.v.)/); the addition of CO_2 significantly inhibited ESF production and blocked the shift in P/sub 50(i.v.)/. The shifts in P/sub 50(i.v.)/ generally followed changes in pH; possibly a lesser influence was exerted by changes in the ADP concentration. The data suggest that increased oxygenation of the whole-body tissues occurs with exposure to 8.8% O_2 + CO_2, as reflected by lower whole-blood excess lactate accumulation. We conclude that the suppression of ESF production is a result of this increased oxygenation. Increased tissue oxygenation with the hypoxic-hypercapnic exposures is probably the result of increased pulmonary ventilation coupled with facilitated oxygen unloading to the tissues as a result of a relatively right-shifted P/sub 50(i.v.)/.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 51144

51147 (BNL—24417) **Postmortem study of stable carbon isotope ratios in human cerebellar DNA: preliminary results.** Slatkin, D.N.; Irsa, A.P.; Friedman, L. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 11p. (CONF-780501—1). Dep. NTIS, PC A02/MF A01.

From 3. international conference on stable isotopes; Oak Brook, IL, USA (23 May 1978).

It is observed that $^{13}C/^{12}C$ ratios in tissue specimens removed postmortem in the United States and Canada are significantly different from corresponding ratios in European specimens. On the basis of this information, measurements of carbon isotope ratios in DNA isolated from cerebella of native-born and European-born North Americans are in progress with the goal of estimating the average

lifetime rate of DNA turnover in human neurons. Preliminary results from twenty postmortem examinations are consistent with the hypothesis that a significant proportion of human cerebellar DNA is renewed during the lifetime of an individual.

51148 Preparation of high-quality ^{125}I-labelled pituitary human follicle-stimulating hormone (hFSH) for radioimmunoassay: comparison of enzymatic and chloramine-T iodination. Pinto, H.; Lerario, A.C.; Torres de Toledo e Souza, I.; Wajchenberg, B.L.; Mattar, E.; Pieroni, R.R. (Univ., Sao Paulo, Brazil). *Clin. Chim. Acta;* **76**: No. 1, 25-34(1 Apr 1977).

A method is described for the enzymatic radioiodination of human follicle-stimulating hormone (hFSH) by a system consisting of lactoperoxidase, hydrogen peroxide and $Na^{125}I$. It was compared with the Chloramine-T modified technique. A satisfactory specific activity of the labelled hormone was obtained with the enzymatic iodination with much greater immunoreactivity with more stability than after Chloramine-T.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 51054, 51290, 51292

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 50421, 50438, 50440, 50445, 50447, 50751, 51179, 51242, 51262, 51263, 51265, 51266

51149 (CONF-770478—P2, pp 1243-1244) **Computer-aided analysis of LANDSAT data on shifting cultivation in East Africa: Preliminary results and further considerations.** Conant, F.P. (Hunter Coll., New York); Cary, T.K. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 51180

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

51150 (DOE-tr—4/7) **Radiobiology.** Translation of *Radiobiologiya;* **18**: No. 1, 1-192(1978). 198p. NTIS, $45.00 per year (six issues) as NTISUB/D/120-01.

Separate abstracts were prepared for the 35 papers presented in this issue of Radiobiology (translation). (ERB)

IN VITRO

REFER ALSO TO CITATION(S) 51221

51151 Effect of gamma radiation on interaction between DNA and nonhistone proteins of chromatin and karyolymph. Umanskii, S.R.; Domashenko, A.D. (Inst. of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 8-16(1978).

Translated from Radiobiologiya: 18: No. 1, 9-15(1978).

Interaction of nonhistone proteins of chromatin (NPC) and proteins of karyolymph (PK) with DNA were studied by two methods: fixation of protein-^{14}C-DNA complexes on nitrocellulose filters and chromatography of ^{32}P-labeled proteins on DNA-containing polyacrylamide-agarose columns. It was shown that irradiated DNA binds somewhat more NPC and PK and much more stably than native DNA. The effect is enhanced with increase in dosage, and it is related to appearance of denatured sites in the DNA. Irradiation of NPC does not have an appreciable effect on their capacity to bind DNA; however, there is impairment of specific interaction between part of the NPC and homologous DNA. The possible role of radiation impairment of interaction between DNA and NPC and PK is discussed, with regard to change in structure and function of chromatin.

51152 Effect of gamma radiation on spectral properties of mouse oxyhemoglobin solutions in the presence of serotonin. Artyukhov, V.G.; Sviridova, E.V. (Voronezh State Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 6-12(1977).

Translated from Radiobiologiya: 17: No. 6, 807-811(1977).

A study of spectral properties of solutions of oxyhemoglobin ($0.5 \cdot 10^{-5}$ M) exposed to γ-quanta in the presence of serotonin ($5 \cdot 10^{-5}$ M) revealed that, under these conditions, serotonin has a protective effect on oxyhemoglobin. The protective effect of serotonin is also manifested with regard to irradiated solutions of oxyhemoglobin preincubated at 45°C for 30 min. It is assumed that the protective action of serotonin may be attributable to formation of an H_2O_2—serotonin complex.

51153 Effect of gamma radiation on phodopsin. Pushkareva, T.V.; Shmelev, G.E.; Sverdlov, A.G. (Leningrad Inst. of Nuclear Physics). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 120-124(1977).

Translated from Radiobiologiya; 17: No. 6, 903-906(1977).

Experiments were conducted using solutions of rhodopsin from digitonin extracts and a suspension of external segments of retinal rods from eyes of cattle. The solutions were exposed to gamma radiation in doses of 10 to 500 krad and observations were made on absorption spectra, photosensitivity, and regenerative capacity. Changes in spectra of solutions irradiated at different PH values showed that there was considerably more change in the protein than in the chromophore; changes were directly related to the configuration of the rhodopsin molecule. Measurements of photosensitivity of rhodopsin indicated a high resistance of chromophore to radiation. The degree of regeneration was the same in control and irradiated solutions. (HLW)

IN MICROORGANISMS

51154 Mechanism of radioprotective action of adeturon on E. coli cells differing in radiosensitivity. Marinova, Ts.; Pantev, T. (Scientific Inst. of Roentgenology and Radiobiology, Sofia). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 53-58(1978).

Translated from Radiobiologiya: 18: No. 1, 46-50(1978).

A study was made of the effect of adeturon on processes of degradation, postradiation synthesis of DNA, and colony-forming capacity of three strains of E. coli differing in radiosensitivity. Adeturon inhibited processes of DNA degradation in cells of the strains tested to about the same degree. The effect of adeturon on DNA synthesis was related to the state of the strain's repair systems. A link was demonstrated between extent of protection and capacity for recovery in the tested strains, and this warrants the belief that adeturon provides protection by intervening in the course of repair. At the same time, the results of experiments dealing with inhibition of DNA degradation are indicative of the possible role of another mechanism.

IN ANIMALS

REFER ALSO TO CITATION(S) 51158

51155 Study of unscheduled DNA synthesis induced by x-rays in the germ cells of male mice. Sega, G.A.; Sotomayor, R.E.; Owens, J.G. (Oak Ridge National Lab., Tenn. (USA). Biology Div.). *Mutat. Res.;* **49**: No. 2, 239-257(Feb 1978).

In vivo DNA repair occurring in meiotic and postmeiotic germ-cell stages of male mice after X-ray treatment has been studied. Making use of the fact that no scheduled DNA synthesis occurs in germ cells after the last S period in primary spermatocytes, and administering testicular injections of [^{3}H]-thymidine, DNA repair after X-ray exposure was measured by the unscheduled incorporation of [^{3}H]-thymidine into germ cells. An exposure-response study showed that UDS (unscheduled DNA synthesis) induced in spermatids is an increasing function of X-ray exposure, at least up to 1000 R. A significant level of UDS was measured in the spermatids at an exposure level of 200 R which is considerably lower than what has generally been required to measure UDS in mammalian cells. When testicular injection of [^{3}H]-thymidine were administered immediately before X-ray treatment, the amount of unscheduled incorporation of [^{3}H]-thymidine into spermatid DNA was maximized. By 4 h following X-ray exposure, no UDS could be detected in the spermetids. This is in marked contrast to the UDS induced in spermetids by alkylating agents such as MMS, EMS, PMS, and IMS, which can still be detected at least 3 days after chemical treatment. In addition, the total amount of UDS measured in spermatids after X-ray treatment is much less than that observed after exposures to these alkylating agents which produce equivalent genetic effects. This may results from relatively fewer repairable DNA lesions being induced by X-rays and from differences in the sizes of the repaired regions. UDS induced after X-ray treatment was detected in the same germ-cell stages (early meiosis through midspermatids) that undergo UDS when exposed to EMS. However, unlike EMS which produces about the same level of UDS in all the germ-cell stages capable of

repair, X-rays appear to produce higher level of UDS in the earlier meiotic stages.

51156 Quantitative analysis of thymus lymphoid cells during murine radioleukemogenesis. Boniver, J.; Simar, L.J.; Courtoy, R.; Betz, E.H. (State Univ. of Liege). *Cancer Res.;* **38**: No. 1, 52-58(Jan 1978).

Fractionated irradiation by four doses of 150 R leads to the development of lymphoma in the thymus of C57BL mice, after a long latent period (4 to 12 months) during which thymic subcapsular blast cells undergo neoplastic transformation. Electron microscope studies on this blast cell population have revealed several types that are distinguishable on the basis of nuclear ultrastructure and activity in the cell cycle. These blast cells are lymphoblasts, ring-shaped nucleolus cells, and x-cells. A stereological analysis demonstrates that the result of the irradiations is not an increase of the thymic blast cell number during the preleukemic period, as generally thought before, but important modifications in the relative proportion of the three cell types forming the blastic population. X-cells, which essentially appear in S phase, are more numerous after the third and fourth doses of radiation. They might be more "sensitive" to the action of the leukemogenic virus and facilitate the leukemogenic process. In contrast, in the preleukemic atrophic thymus just before the appearance of the lymphoma, x-cells are scarce, and ring-shaped nucleolus cells are more frequent than in the controls, suggesting important changes in thymus cell kinetics. The only modification detected in the blast cells at any time after irradiation concerns the surface of Golgi membranes, which decreases in x-cells and ring-shaped nucleolus cells of the atrophic thymus. Because the same change is observed later on in the lymphomatous cells, it is suggested that the change might be related to the transformation of the thymic blast cells into cancerous cells.

51157 Effect of radiation on alkaline DNAase activity in rat thymocytes. Ivannik, B.P.; Proskuryakov, S.Ya.; Golubeva, R.V.; Ryabchenko, N.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 1-7(1978).

Translated from Radiobiologiya: 18: No. 1, 3-8(1978).

Determination was made of changes in activity of alkaline DNAase in irradiated rat thymocytes using a modified viscosimetric method. Alkaline DNAase activity increases 4 h after irradiation by 2.17, 3.33, and 4.50 times with delivery of 500, 900, and 3000 R, respectively. There is a 4.21-, 6.18-, and 7.83-fold increase in activity of DNAase 6 h after delivery of radiation in doses of 500, 900, and 3000 R, respectively. For the first 3 h after exposure to a dosage of 3000 R, there is virtually no change in DNAase activity, while it demonstrates a 1.32-fold increase 3 h after irradiation.

RADIATION EFFECTS ON CELLS

REFER ALSO TO CITATION(S) 51150

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 51186, 51224, 51225

51158 (CONF-780226—9) **DNA damage and mammalian cell killing.** Elkind, M.M. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From Symposium on DNA repair mechanisms; Keystone, CO, USA (19 Feb 1978).

DNA lesions--particularly single- and double-strand breaks--are induced in considerable excess by doses required to register one lethal hit. In the case of x-ray cell killing, the disposition of such damage has been determined in the progeny of surviving cells. Fewer than 0.2% of the single- and 6.0% of the double-strand breaks are propagated. Hence, it is likely that in surviving cells all breaks are repaired. A mechanism of x-ray cell killing based upon misrepair of DNA breaks is proposed.

51159 (ORAU/IEA—78-2(R), pp 80-89) **Radiation-induced DNA lesions and their repair in mammalian cells.** Painter, R.B. (Univ. of California, San Francisco). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: single-strand breaks in DNA; end groups formed by x radiation in DNA; components of single-strand break repair; repair of ^{125}I-induced single-strand breaks in DNA; excision repair of DNA; studies on DNA repair using cells from xeroderma pigmentosum patients; induction of interstrand DNA cross-links by derivatives of nitrogen mustard; DNA-protein cross-links; association of nu bodies and DNA in chromatin structure; and evidence for higher levels of supercoiling. (HLW)

51160 (ORAU/IEA—78-2(R), pp 90-94) **Repair in mammalian cells.** Elkind, M.M. (Argonne National Lab., IL). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: repair of cultured hamster cells following x ray and fission neutron damage; repair of radioinduced single-strand breaks in DNA; repair of cells damaged by additive effects of near uv and x radiation; and RBE of fission neutrons and x rays for single and fractionated doses to cultured mouse cells. (HLW)

51161 (ORAU/IEA—78-2(R), pp 197-207) **Model of cancer induction with immunity.** Hutchins, B.A. (General Electric Co., Sunnyvale, CA). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: model for extracellular immunity; destruction of tumor cells by immune substances; rate of change in density of tumor cells; model for effects of chronic dose of penetrating radiation; rate of change of density of immune units; and cancer latent period as a function of dose rate. (HLW)

51162 Enhancement of postreplication repair in ultraviolet-light-irradiated Chinese hamster cells by irradiation in G_2 or s-phase. D'Ambrosio, S.M.; Aebersold, P.M.; Setlow, R.B. (Brookhaven National Lab., Upton, NY). *Biophys. J.;* **23**: No. 1, 71-78(Jul 1978).

Postreplication repair in synchronous Chinese hamster cells was determined after split doses of ultraviolet (uv) radiation. Repair was enhanced by irradiation of cells in G_2 or S-phase with a small dose of uv radiation at least 1.5 h before a three-fold larger dose of uv. There was significantly greater enhancement when the first dose was given in G_2 than when it was given in the S-phase 0.5 to 1.5 h before the test dose. These data indicate that enhancement of postreplication repair does not require active DNA replication and qualitatively is independent of when in the cell cycle the cells are irradiated.

51163 Cell-free assay measuring repair DNA synthesis in human fibroblasts. Ciarrocchi, G.; Linn, S. (Univ. of California, Berkeley). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 4, 1887-1891(Apr 1978).

Osmotic disruption of confluent cultured human fibroblasts that have been irradiated or exposed to chemical carcinogens allows the specific measurement of repair DNA synthesis using dTTP as a precursor. Fibroblasts similarly prepared from various xeroderma pigmentosum cell lines show the deficiencies of uv-induced DNA synthesis predicted from in vivo studies, while giving normal responses to methylmethanesulfonate. A pyrimidine-dimer-specific enzyme, T4 endonuclease V, stimulated the rate of uv-induced repair synthesis with normal and xeroderma pigmentosum cell lines. This system should prove useful for identifying agents that induce DNA repair, and cells that respond abnormally to such induction. It should also be applicable to an in vitro complementation assay with repair-defective cells and proteins obtained from repair-proficient cells. Finally, by using actively growing fibroblasts and thymidine in the system, DNA replication can be measured and studied in vitro.

51164 Evidence that pyrimidine dimers in DNA can give rise to tumors. Hart, R.W.; Setlow, R.B.; Woodhead, A.D. (Brookhaven National Lab., Upton, NY). *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 12, 5574-5578(Dec 1977).

The Amazon molly, Poecilia formosa, is a small fish that grows in clones. Hence, cells from one animal may be transplanted to another without danger of rejection. Cells from thyroid and adjacent tissue were irradiated with uv light in vitro and injected into the abdominal cavity of isogeneic recipients. At appropriate uv doses and numbers of cells injected, all recipients showed exuberant thyroid proliferation. We give arguments and data indicating that the proliferation is a tumor, not a goitrogenic response. If the uv irradiation is followed, but not preceded, by photoreactivating illumination, the yield of thyroid growths is markedly decreased. Because other investigations have shown that photoreactivation monomerizes uv-induced cyclobutylpyrimidine dimers in DNA and does not affect other photoproducts, our data indicate that pyrimidine dimers in DNA can give rise to tumors.

51165 DNA excision repair in ultraviolet-irradiated normal and malignantly transformed mouse epidermal cell clutures. Bowden, G.T.; Hohneck, G.; Fusenig, N.E. (German Cancer Research Center, Heidelberg). *Cancer Res.;* **37**: No. 6, 1611-1617(Jun 1977).

Pyrimidine dimer production and excision was studied in ultraviolet light (UV)-irradiated primary cultures of epidermal cells derived from perinatal mouse skin and in an in vitro malignantly transformed epidermal cell line. Dimer production increased linearly with UV dose level for both cell types. However, at any given UV

dose level, there were 20% fewer thymine-containing dimers induced in the primary cultures compared to the transformed cell line. The reduced dimer yield in the primary cultures was attributed to the multilayer (three cell layers) of these cultures. The primary cultures were found to excise no more than 10% of the original dimers in a 24-hr period, while the malignantly transformed cells excised 34%. Nonsemiconservative DNA repair synthesis was also studied as a function of dimer yields in the first 3 hr after irradiation. When the levels of repair replication in both cell types were compared at equal yields of UV-induced dimers, the malignantly transformed cells exhibited a higher level of repair than did the primary epidermal cells. There was no difference in the kinetics of repair replication between the two cell types at a UV dose level of 10 J/sq m over the first 6 hr after irradiation.

51166 Molecular and cellular biology of radiation lethality. Elkind, M.M. (Argonne National Lab., IL); Redpath, J.L. pp 51-99 of Cancer: a comprehensive treatise. Vol. 6. Becker, F.F. (ed.). New York; Plenum Publishing Corp. (1977).

Radiation lethality of pracaryotes is reviewed with regard to DNA lesions and their repair; physical and chemical parameters affecting DNA; effects of dose rate and LET; oxygen sensitization; and DNA membrane targets. Radiation lethality of mammalian cells is reviewed with regard to damage and repair related to survival; repair of sublethal damage; targets containing DNA; low dose irradiation; hyperthermia and dose fractionation; radioinduced DNA breaks; changes in sedimentation due to small x-ray doses; hyperthermia and repair of DNA; DNA repair after fluorescent-light exposure of BUdR-containing cells; and general features of mammalian cell killing. (HLW)

51167 Increased effectiveness of irradiation of cells in the logarithmic and stationary phases of growth after treatment with N-methyl-N-nitrosourea. Afanas'ev, G.G.; Gotlib, V.Ya.; Pelevina, I.I. (Inst. of Chemical Physics, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 26-31(1977).

Translated from Radiobiologiya: 17: No. 6, 823-827(1977).

It was demonstrated, in experiments on LL cell cultures obtained from NKLy ascites lymphosarcoma of mice, that the curve of cell survival as function of dosage of methylnitrosourea is deprived of an arm at the logarithmic stage of growth, unlike cells in the stationary phase; in these populations, there are insignificant differences in values of D_0 doses. When added before and after irradiation, methyl nitrosourea increases radiation destruction of cells, and it is more effective when added before irradiation. The authors discuss molecular and cellular mechanisms of enhancement of effectiveness of radiation by methyl nitrosourea.

51168 Biological dosimeter for fast protons. Report 1. Accuracy of dose estimation after exposing human blood lymphocytes to high-energy protons. Totseva, A.; Dermendzhiev, E. (Inst. of Nuclear Research and Nuclear Energy, Sofia). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 99-103(1977).

Translated from Radiobiologiya: 17: No. 6, 886-889(1977).

The problem of estimation of radiation dosage according to cytogenetic effects is discussed. On the basis of analysis of data pertaining to irradiation of human blood lymphocytes with protons, with E/sub p/ = 645 MeV, an estimate is made of dose determination error factor, the source of which is the low degree of accuracy of dose-effect curves. It was shown that the error of dose determination is 50 percent or more in the range of doses that is significant in practice (D less than or equal to 50 rad).

RADIATION EFFECTS ON MICROORGANISMS

REFER ALSO TO CITATION(S) 51150

BASIC STUDIES

REFER ALSO TO CITATION(S) 51154

51169 (ORAU/IEA—78-2(R), pp 95-101) **Repair, persistent DNA lesions, and thresholds.** Billen, D. (Oak Ridge Associated Universities, TN). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: importance of DNA damage not repaired by excision repair in comparison to amount of unscheduled DNA synthesis; enzymes involved in excision repair; excision repair and recombinational repair in mutant of Escherichia coli; effects of mutagens and carcinogens on DNA; selectivity for repair of modified bases in DNA; and stimulation of DNA-polymerase-I-directed repair synthesis by methylmethane sulfonate. (HLW)

51170 Effects of some mutations on radiosensitivity of haploid and diploid yeast. Sokurova, E.N.; Korogodin, V.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 22-28(1978).

Translated from Radiobiologiya: 18: No. 1, 20-25(1978).

A series of haploid strains of Saccharomyces cerevisiae yeast is described, which differ by almost 100% in radiosensitivity (D_0 5.7 to 10.8 krad). The diploid strains obtained from them by means of self-diploidization and hybridization demonstrated a 5-fold difference in radiosensitivity (D_0 9.6 to 50.0 krad). It was established that some mutations (presumably adel-6) can affect the radiosensitivity of haploid and diploid yeasts in opposite directions, i.e., they can lower the radiosensitivity of haploid cells and raise that of diploid cells. It was demonstrated that the effect on radiosensitivity of such mutations is independent of heterozygosity for the mating [pairing] type locus. No correlation was established between the changes in values of D_0, extrapolation number n, inactivation form ratio, and level of recovery when kept in a non-nutrient medium.

51171 Endogenous thiol content of budding and resting yeast cells. Simonyan, N.V.; Avakyan, Ts.M.; Zhanpoladyan, N.L. (Erevan Physical Inst.). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 36-40(1978).

Translated from Radiobiologiya: 18: No. 1, 32-35(1978).

Data are submitted on levels of endogenous thiols and radioresistance of cells in a culture of Saccharomyces ellipsoideus Megri 139-B diploid yeast of the same age, but with different amounts of budding cells. It was shown that the cells of yeast cultures with a high budding cell content have more endogenous thiols and are more radioresistant than cells in cultures with fewer budding cells.

51172 Investigation of capacity for postradiation recovery of bacteria of the genus Vibrio when gamma-irradiated cells are incubated in phosphate buffer (pH 8.6) and when cultured on various nutrient media. Sokurova, E.N. (Scientific Research Inst. of Medical Radiology, Obninsk). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 41-45(1978).

Translated from Radiobiologiya: 18: No. 1, 36-39(1978).

Data were obtained indicating that bacteria of the genus Vibrio have no systems for implementing recovery from lesions induced by γ radiation when the cells are incubated in phosphate buffer (pH 8.6), as well as on the surface of agar nutrient media.

51173 RBE and shape of survival curves as function of phase of growth of Endomyces magnusii. Petin, V.G.; Kabakova, N.M. (Scientific Research Inst. of Medical Radiology, Obninsk). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 46-52(1978).

Translated from Radiobiologiya: 18: No. 1, 40-45(1978).

A comparative study of RBE [relative biological effectiveness] of α irradiation of yeast cells that multiply by division revealed that the survival curves after exposure to both γ and α radiation are sigmoidal at the stationary phase of growth; at the logarithmic phase, the survival curve referable to γ radiation is sigmoidal and that referable to α radiation is exponential. The RBE of α particles at the stationary phase of growth changed from 5.0 to 7.0 with delivery of doses of 10 to 180 krad. At the logarithmic stage, RBE rose sharply from 3.2 to 14 in the range of low doses of radiation. The possible causes of difference in relationship of RBE to dosage in the stationary and logarithmic phases of growth are discussed.

51174 Radiosensitivity and sulfhydryl group content of yeast of different genotypes. Korogodin, V.I.; Graevskii, E.Ya.; Korogodina, Yu.V.; Nekrasova, I.V.; Petin, V.G. (All-Union Scientific Research Inst. of Genetics and Breeding of Industrial Microorganisms, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 39-44(1977).

Translated from Radiobiologiya: 17: No. 6, 834-838(1977).

A study was made of radiosensitivity and sulfhydryl group content of haploid and diploid Saccharomyces cerevisiae yeast of the "wild type" with the rad 54 mutation. It was established that, in "wild type" yeast, cells in the logarithmic phase of growth are not only more radioresistant than cells in the stationary phase of growth, but they contain more SH groups. In yeast carrying the rad 54 mutation, cells in the logarithmic phase of growth differ little from those in the stationary phase, with regard to both radioresistance and SH group content. No substantial differences were demonstrated in SH group content of haploid and diploid cells of different genotypes at the stationary phase of growth. The hypothesis is expounded that the influence of the rad 54 mutation on differences in radiosensitivity of yeast in different growth phases may be related to the disturbances in regulation of SH compound synthesis induced by this mutation.

RADIOSTERILIZATION OF MEDICAL SUPPLIES

51175 Use of gamma radiation for preparation of nutrient culture media. Speranskaya, I.D.; Tumanyan, M.A.; Mironova, L.L. (Inst. of

Poliomyelitis and Viral Encephalitis, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 94-98(1977).

Translated from Radiobiologiya: 17: No. 6, 881-885(1977).

A technique was developed for sterilization of nutrient culture media using γ-radiation. For this purpose, dry preparations were exposed to 3 to 6 Mrad radiation, then dissolved in sterile distilled water. The quality of media and solutions thus obtained is as good as that of preparations sterilized by filtration. The advantage of the proposed sterilization method is that liquid media can be rapidly prepared and dry sterile media can be stored at room temperature for long periods of time.

VACCINE PREPARATION AND OTHER APPLICATIONS

51176 Effect of x rays on virus production and DNA synthesis in adenovirus-infected cells. Majle, T.; Semkow, R.; Gorzkowski, B. (National Inst. of Hygiene, Warsaw). *Acta Microbiol. Pol.;* **26**: No. 1, 27-33(1977).

The effect of X rays on the process of type 10 adenovirus infection in HeLa cells was tested. CPE development and virus infections titer were lower in the irradiated cells, while CF titer remained unchanged. The rate of DNA synthesis, as measured by ^{3}H-thymidine incorporation, was higher in the infected cells and radiosensitivity of the process was higher in the infected cells compared with uninfected controls.

RADIATION EFFECTS ON PLANTS

REFER ALSO TO CITATION(S) 51150

BASIC STUDIES

REFER ALSO TO CITATION(S) 51221

51177 (NVO—178, pp 351-378) **Chronic radiation induced chromosomal aberrations in native shrubs at Nevada Test Site.** Varney, D.M.; Rhoads, W.A. (EG and G, Santa Barbara, CA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

Radiation effects at the morphological and phenological level within vegetation at NTS have been looked for almost from the start of nuclear testing in Nevada, and have, within the last decade been described both for areas contaminated with nuclear debris and for the vicinities of experimental radiation sources. Radiation effects at the chromosomal level of plant organization in radiation contaminated natural environments apparently have neither been sought nor observed. Artemisia spinescens shrubs from Site D, Area 11, Plutonium Valley NTS which have been irradiated since 1956 with uncertain doses estimated to range from 35 R to 140 R for a ten year period proved to have chromosomes quite suitable for microscopic examination. Meiotic pollen mother cells from A. spinescens showed, among seven classes of chromosome aberrants, 14.2% aberrants chromosomes compared to 3.8% from plants about one mile south outside the Plutonium Valley enclosure where background radiation levels occurred. These values were not statistically significant at conventionally accepted levels of significance; however when the highest percentage occurrence in each population was omitted, the difference was significant at the 95% level. For comparison two other shrub species from UCLA's Rock Valley experimentally irradiated plot, also chronically irradiated at 2.5 to 4.8 R/day since 1964 to doses very much higher than those at Site D, were also investigated. Both species showed chromosome aberrations and in one species, Krameria parvifolia, the difference in occurrence of chromosome aberrants was different statistically for the higher radiation doses. The same kinds of chromosome aberrants were noted for all species studies and these were the kinds of aberrants noted as resulting from experimental radiation doses in the laboratory.

51178 Effect of gamma radiation on fraction and amino acid composition of cotton plant ribosomal proteins in ontogenesis. Ibragimov, A.P.; Rakhmatov, N.A. (Inst. of Biochemistry, Tashkent). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 119-123(1978).

Translated from Radiobiologiya; 18: No. 1, 100-103(1978).

Data have appeared in the recent literature concerning studies of the effects of ionizing radiation on the subcellular structures, plant ribosomes. They indicate that the levels of the tested components change when plant seeds are exposed to radiation and they subsequently germinate, depending on the radiation dose and phase of seed germination. We previously observed that there is a change in fraction and amino acid composition of ribosomal proteins of the cotton plant under the influence of γ radiation. The objective of this work was to test the effects of different doses of γ radiation on fraction and amino acid composition of ribosomal proteins of the cotton plant in ontogenesis.

51179 Effect of gamma radiation on hardiness of Ul'yanovka winter wheat. Puzakova, A.I.; Kovshova, N.I.; Kostin, V.I. (Ul'yanovsk State Pedagogical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 181-185(1978).

Translated from Radiobiologiya; 18: No. 1, 149-152(1978).

Most authors attribute significance to some prominent aspect of metabolism or other in processes of resistance to low temperature. Some related hardiness to watering, bound water content of the plant, while others relate resistance to low temperature to accumulation of monosaccharides, oligosaccharides, and nonprotein forms of nitrogen. A scrutiny of the data obtained by different researchers revealed that radiation and low temperatures, which are very different factors but which have rather intensive action, lead to impairment of the same processes. Nucleic metabolism is impaired under the influence of irradiation as well as low temperatures. Depression of protein synthesis and intensification of activity of proteolytic enzymes occur under the influence of radiation and low temperatures. Carbohydrates accumulate under the effect of radiation and low temperatures. Since radiation and low temperatures, when of a sufficient intensity, elicit in plants similar changes in physiological and biochemical processes, we assumed that radiation in specific doses may be considered as a factor that affects processes related to hibernation of plants. There was a report of increased plant survival under the influence of low doses of radiation, and this served as the grounds for a continued study of the effects of γ radiation on winter wheat.

51180 Effects of exposing pepper seeds to ^{60}Co gamma rays prior to sowing. Mal'tseva, S. (Inst. of Genetics, Sofia). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 186-189(1978).

Translated from Radiobiologiya; 18: No. 1, 152-155(1978).

It has been established in the literature that low doses of ionizing radiation have a beneficial effect on the plant organism: energy of seed sprouting increases, growth and development of plants are stimulated, fruit ripens faster, the harvest increases, and the quality of products is improved. We have demonstrated a high stimulating effect, according to several parameters, in tomatoes and eggplant. Since no studies had been conducted in this direction on such an important vegetable as the pepper, we decided to investigate the reaction of this plant to ionizing radiation, used to induce earlier ripening and a higher yield.

51181 Effect of antibiotic pretreatment on survival, mutability, and electrophoretic spectrum of soluble proteins in a gamma-irradiated chlorella population. Ovsyannikova, M.N.; Osetrova, A.Ya. (Inst. of Chemical Physics, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 13-19(1977).

Translated from Radiobiologiya: 17: No. 6, 812-817(1977).

A study was made of the protective action of several antibiotics in a γ-irradiated chlorella population. It was shown that not all of the antibiotics tested had a protective effect with regard to survival. At the same time, all of the tested antibiotics, with the exception of nistatin, diminished the effectiveness of subsequent γ-irradiation with respect to induction of mutations. It is assumed that electrophoresis of readily soluble proteins can be used for biochemical identification of mutations in the population.

51182 Biostack-2 experiment. Report 3. Investigation of biological effects of heavy ions of galactic cosmic radiation on Arabidopsis thaliana seeds. Abramova, V.M.; Asaturyan, V.I.; Benevolenskii, V.N.; Vasil'eva, N.G. (Inst. of Biomedical Problems, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 80-84(1977).

Translated from Radiobiologiya: 17: No. 6, 870-873(1977).

In an experiment on Kosmos-690, an artificial satellite of earth, data were obtained concerning the high lethal effect of ionizing particles with z greater than or equal to 8 and LET greater than or equal to 150 keV/μm on seeds of Arabidopsis thaliana L., race En-1. The seeds that survived after particles hit the region of the embryo had a statistically reliable smaller number of normal offspring.

51183 Radiostimulating effect of cobalt 60 gamma rays as function of dose rate in experiments with tomatoes. Maltseva, S. (Inst. of Plant Genetics and Breeding, Sofia). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 136-138(1977).

Translated from Radiobiologiya; 17: No. 6, 915-918(1977).

Seeds of tomatoes were exposed to 2000 R of gamma radiation at dose rates of 17 to 1000 R/min. The seeds were planted and observations were made on sprouting, growth dynamics, and development of plants. Plants that grew from seeds irradiated at rates of 17 to 317 R/min were taller than those exposed to the same dose at a rate of 1000 R/min. Similar effects of dose rate were observed on flower and ripening of fruit. (HLW)

51184 Effect of exposure of garden rose cuttings to gamma radiation on development and morphological variability. Klimenko, Z.K.; Zykov, K.I.; Shanin, E.V. (Nikitskii State Botanical Gardens,

Yalta, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 152-155(1977).

Translated from Radiobiologiya; 17: No. 6, 928-930(1977).

Cuttings of rose plants were exposed to gamma radiation in doses of 1 to 10 kR. The irradiated cuttings were placed in beds of a fog-producing device for rooting and also used for grafting on Rosa canina by the inoculation method. Rooting was observed only in the 1 to 7 kR dose range. Irradiation in doses of more than 3 kR retarded rooting and budding by 1 to 2 months and development of runners by 6 to 12 months. With a dose of 7 kR there was severe depression of growth, reduced deformed leaves, and drying of runners. A higher yield of grafted plants was observed with the use of irradiated buds. It was concluded that the use of gamma radiation followed by grafting is a promising method for obtaining new and diverse characters. (HLW)

RADIATION EFFECTS ON ANIMALS

REFER ALSO TO CITATION(S) 51150

MAN

REFER ALSO TO CITATION(S) 51130

51185 (NVO—178, pp 17-24) **Off-site medical activities, Nevada Test Site and the medical liaison officer network: a historical review.** van der Smissen, E. (Public Health Marine Hospital, Galveston, TX); Kaye, M.E. Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

The "off-site" was originally defined as "that area surrounding the Nevada Test Site (NTS) for a radius of about 300 miles." Prior to 1954, the off-site radiological safety activities were conducted by the Atomic Energy Commission. In 1954, the Public Health Service was given the responsibility for off-site monitoring, and, in addition, a physician was also on temporary assignment. This physician, in addition to functioning as a monitor, also functioned part time as a physical liaison in regard to possible or alleged radiation injury. Medical concern was based upon two crude guidelines: possible radiation "overexposure" based upon extrapolation from surface and air radiological monitoring; and determination of actual radiation injury based upon signs and symptoms among people alleging radiation injury. The area of concern expanded to 13 areas surrounding the Nevada Test Site, and in 1956, the first Medical Liaison Officer Network (MLON) was initiated. Over the years, MLON increased to a point where there was a representative from every state in the Union; the area of concern expanded to include the entire United States, parts of the South Pacific, Hawaii, and Alaska; and sophisticated methods of evaluation were added—urine sampling, thyroid scanning, blood counts, and whole-body counting. Epidemiological studies were initiated on body burdens of radionuclides and certain disease clusters.

51186 (ORAU/IEA—78-2(R)) **Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.** Billen, D. (ed.). (Oak Ridge Associated Universities, Inc., Tenn. (USA). Inst. for Energy Analysis). Feb 1978. Contract EY-76-C-05-0033. 227p. (CONF-770663—). Dep. NTIS, PC A11/MF A01.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

Separate abstracts were prepared for the 18 papers presented at the workshop. (HLW)

51187 (ORAU/IEA—78-2(R), pp 9-15) **Repair mechanisms and exposure standards.** Mills, W.A. (Environmental Protection Agency, Washington, DC). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed; public policy for setting radiation standards; use of linear, nonthreshold theory in setting radiation standards; dose-rate dependence; occupational exposure to radiation; radon inhalation from radium in the soil in the vicinity of the phosphate industry; relation of repair mechanisms for cell survival to cancer induction; application of information on genetic repair to humans and to cancer induction; importance of repair processes in radiation protection standards; corrective factors for repair processes; relation of repair processes to age, sex, and other factors; and population distribution in radiosensitivity. (HLW)

51188 (ORAU/IEA—78-2(R), pp 25-36) **Historical perspectives on standards setting.** Taylor, L.S. (National Council for Radiation Protection and Measurements, Washington, DC). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: radiation measurements using ionization chambers; use of threshold-erythema dose for describing radiation effects in terms of distance, time, field size, and frequency of irradiation; radiation energies of therapy equipment; determination in Sweden and England that a tenth of an erythema dose per year would be satisfactory level for people to work at; survey of installations in Germany to determine number of roentgens to produce threshold erythema dose; and recommendations of the U.S. Advisory Committee on x rays and radium protection in 1954. (HLW)

51189 (ORAU/IEA—78-2(R), pp 76-79) **Mutational repair in mammals and its bearing on risk assessment.** Russell, W.L. (Oak Ridge National Lab., TN). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: effects of dose rate on mutation frequency in spermatogonia and oocytes of mice; radioinduced mutations in oocytes at various stages of development, sensitivity of mouse arrested oocytes to killing by radiation; sensitivity of mature oocytes to mutation induction by acute, high dose rate irradiation with large doses; effective repair capability of mature oocytes; comparison of mutation frequency at low dose rates in spermatogonia and oocytes; and use of mouse data for establishing maximum permissible levels of radiation. (HLW)

51190 (ORAU/IEA—78-2(R), pp 106-144) **DNA repair and the assessment of radiation hazards.** Myers, D.K. (Chalk River Nuclear Labs., Ont.). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: induction of cancer in persons exposed to ionizing radiation; induction of genetic defects in offspring of persons exposed to radiation; current estimates of causes of cancer in humans with regard to dietary factors, cigarette smoking, background radiation, and sunlight; linear extrapolation of radiation risks from high doses to low doses as a method of estimation of risks; repair of DNA damage caused by low LET and high LET radiation; and current risk estimates for radiation hazards. (HLW)

51191 (ORAU/IEA—78-2(R), pp 145-157) **Studies on the increase in risk on dying from cancer.** Totter, J.R. (Oak Ridge Associated Universities, TN). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: linear response in no-threshold situation; difficulties of single-bit theory; biological factors in repair capacity; selection pressure to improve repair or elimination of lesions that cause cancer; and repair capability distribution curve in relation to cause of cancer. (HLW)

51192 (ORAU/IEA—78-2(R), pp 177-184) **Rationale for nonlinear dose-response functions of power greater or less than one.** Baum, J.W. (Brookhaven National Lab., Upton, NY). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: incidence of skin cancer versus dose; analysis of Japanese data for dose-response functions; standard setting on linear extrapolation; use of human mortality data to determine dose-effect curves; and relation of radiosensitivity of a population to cancer mortality rate. (HLW)

51193 **Computed tomographic scanning in children: comparison of radiation dose and resolving power of commercial CT scanners.** Brasch, R.C.; Boyd, D.P.; Gooding, C.A. (Univ. of California, San Francisco). *Am. J. Roentgenol.;* **131**: No. 1, 95-101(Jul 1978).

From Annual meeting of the Society for Pediatric Radiology; Boston, MA, USA (Sep 1977).

Surface and internal radiation doses for abdominal computed tomography (CT) of children were determined using child-sized phantoms and seven models of CT body scanners. Resolving power of each scanner was determined simultaneously with the radiation dose determination. The average surface skin dose for a complete CT body examination ranged from 0.39 to 5.60 rad, varying with patient size and model of CT scanner employed. A high contrast

(12%) resolving power phantom of water-filled holes in acrylic showed a range of 1.75 to 2.25 mm.

51194 Acute nonlymphocytic leukemia in malignant lymphoma: a morphologic study. Vardiman, J.W.; Golomb, H.M.; Rowley, J.D.; Variakojis, D. (Univ. of Chicago). *Cancer;* **42**: No. 1, 229-242(Jul 1978).

Ten patients who developed acute nonlymphocytic leukemia 29 to 132 months after a diagnosis of malignant lymphoma are described. Six of these patients had Hodgkin's disease, and four patients had non-Hodgkin's lymphoma. All received radiotherapy or chemotherapy, or both. A preleukemic period with peripheral blood and bone marrow changes was present in 6 patients. Nucleated red cells, macrocytosis and marked anisopoikilocytosis of red cells, and occasional myelocytes and promyelocytes were early changes in the peripheral blood in this group. Erythroid hyperplasia with megaloblastoid features, a mild to moderate shift toward granulocytic immaturity, increased numbers of megakaryocytes with cytologic abnormalities, and increased amounts of reticulin were found in the bone marrow. As overt myelogenous leukemia evolved, serial marrow studies in 5 of the 6 preleukemic patients showed a gradual increase in the numbers of blasts and in the amount of reticulin, a decrease in numbers of megakaryocytes, and a decrease in numbers of erythroid precursors. The sixth patient developed erythroleukemia. Two of the 10 patients had no apparent preleukemic phase, and information on two others was insufficient for a determination whether a preleukemic period existed. Cytochemical studies in all cases confirmed the nonlymphocytic nature of the leukemia.

51195 Biological effects of ^{224}Ra. Benefit and risk of therapeutic application. Mueller, W.A.; Ebert, H.G. Boston; Martinus Nijhoff Medical Division (1978). 243p. (CONF-760992—).

From 2. international symposium on biological effects of Ra-224; Neuherberg/Muenchen, F.R. Germany (20 Sep 1976).

The Second Symposium on the Biological Effects of ^{224}Ra, held at Neuherberg, was focused on two topical aspects of radiation protection. One aspect was the long-term effects of high-LET ionizing radiation on man and the quantitative data involved in risk assessment at low doses. The evaluation of epidemiological studies and experimental research was discussed in order to provide facts and figures contributing to an objective assessment of the radiation hazard from incorporated radionuclides. The other aspect was that of radiation protection in medicine. In the case of ^{224}Ra treatment of ankylosing spondylitis the questions of benefit and risk of this therapeutic use of ionizing radiations were discussed, the aim being to achieve the therapeutic effect while reducing radiation exposure-- and therefore the hazard-- to a minimum. The proceedings contain the complete texts of 23 papers as well as the final round table discussions.

51196 Studies on simulating equation of integral dose for 60-cobalt irradiations. Kato, H. (Aichi Medical Univ. Hospital (Japan)). *Nippon Hoshasen Gijutsu Gakkai Zasshi;* **33**: No. 2, 141-146(Jul 1977). (In Japanese).

A widely applicable simulating equation useful for radiotherapy was obtained on the basis of the conception of energy flux, by using the theory of interaction between a substance and photons, with cobalt-60 irradiation as an example. The integral dose can be expressed by the difference between the total incident energy into a patient body and the total emitted energy from the patient body, according to the principle of the energy flux. After theoretical treatment, the following simulating equation was obtained. ID = Dd x [1/TAR(d, A)] x [1/(mu/rho)] x A[1-exp(-0.043 Th + 0.123)], where ID is the integral dose (g, rad); Dd is tumor dose (depth d) (rad); (mu/rho) represents the mass energy absorption coefficient (0.0295); A is the field area at depth d (square centimeter); and Th is the thickness of irradiated body (cm). A calculated value according to the present equation was compared with the value obtained from the curve of isodose chart and with the value calculated from Mayneord approximate equation. As a result, the value according to the present equation conformed to the value obtained from the curve of isodose chart, therefore the present equation can be used widely. In addition, the present equation is applicable to moving and conformation teletherapies, when the value of average distance between skin and rotation axis average field size and the average thickness of an irradiated body are introduced.

VERTEBRATES

REFER ALSO TO CITATION(S) 51155, 51157, 51189

51197 (ORAU/IEA—78-2(R), pp 158-176) **Quadratic dose dependence for life shortening in mammals: experimental data and a mechanistic model.** Sacher, G.A. (Argonne National Lab., IL). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: radioinduced tumors in mice; comparison of single dose and fractionated dose effects on life shortening; time constant for repair of cellular damage following split-dose irradiation; mathematical models of dose effects; and range of variation of crossover doses. (HLW)

51198 (ORAU/IEA—78-2(R), pp 187-196) **Repair of radiation injury by transplantation of hemopoietic tissue.** Smith, L.H. (Oak Ridge National Lab., TN). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: endogenous repair of tissue by surviving cells; exogenous repair by transplantation of tissue from unirradiated donor; repair of hematopoietic tissue following sublethal exposure or exposure in the LD_1 to LD_{100} range; early studies on regeneration of hematopoietic tissue in x-irradiated dogs by giving bone marrow; hypotheses as to how bone marrow injections result in regeneration of blood-forming tissue; effects of rat bone marrow transplants on survival of lethally irradiated mice; and effect of tissue transplants on dose-response curve. (HLW)

51199 Ovarian tumor types and their incidence in intat mice following whole-body exposure to ionizing radiation. Clapp. N.K. (Oak Ridge National Lab., TN). *Radiat. Res.;* **74**: No. 3, 405-414(Jun 1978).

Over 3100 young adult female RF/Un mice were given 0 to 400 rad of whole-body irradiation with 60-MeV protons or 300-kVp x rays in single doses at a dose rate of 80 to 100 rad/min. Only slight differences in ovarian tumor induction existed between types of radiation. Untreated mice developed 3.8% ovarian tumors, 50 to 60% incidence was seen after 50 to 100 rad, and a gradual decline in incidence was observed from 100 to 400 rads. Tumor cell types (primarily luteal cell, granulosa cell, and tubular adenoma) were identified histologically in 2400 mice, and tumors were characterized as single-cell or mixed-cell type. From 0 to 100 rad, relative proportions of mixed-cell tumors increased and single-cell tumors decreased; they were about equal from 100 to 400 rad. Approximately 90% of the ovarian tumors at 50 rad contained tubular adenoma elements; this decreased to 70% at 400 rad. Luteomas increased to 40% at 50 rad and 60% at 100 rad and showed no dose effect from 100 to 400 rad. Granulosa cell tumors showed no dose effect, remaining at an incidence of 15 to 20% from 50 to 400 rad. A comparison of the difference between control values and the incidence of various cell types at the lowest dose (50 rad) showed that tubular adenomatous tumors were most common, luteal were intermediate, and granulosa cell were lowest in occurrence. These results suggest a relative radiosensitivity of these ovarian tissues for tumor production in the intact-animal conditions used in this study.

51200 Late ultrastructural changes in the mouse coronary arteries and aorta after fission neutron or ^{60}Co γ irradiation. Yang, V.V.; Stearner, S.P.; Ainsworth, E.J. (Argonne National Lab., IL). *Radiat. Res.;* **74**: No. 3, 436-456(Jun 1978).

The ultrastructure of the coronary arteries and the aorta of the $B6CF_1$ mouse from 1 to 24 months after irradiation is described. Radiation treatment, initiated at 4 months of age, included single total-body doses of 788 γ rad or 240 fission neutron rad, and fractionated total-body doses of 823 γ rad or 240 fission neutron rad (24 fractions given in 23 weeks). In addition, mice given the high γ dose of 2690 rad (fractionated), and relatively low neutron doses (80 rad single and 20 or 80 rad fractionated) were studied at 18 months after initiation of irradiation in order to increase the dose range for estimation of the relative biological effectiveness (RBE). In control mice, at 12 months into the experiment, there was little evidence of degeneration of the coronary arteries and aorta. At 18 months, these vessels showed a slight amount of smooth muscle degeneration and fibrosis, while at 24 months lesions were more severe and there was relatively less distinction between control and treated groups (788 γ rad or 240 neutron rad). Degenerative changes in the larger coronary arteries and the aorta first appeared at 3 to 6 months after irradiation, and became progressively more severe at later times (12 to 24 months). The major changes included smooth muscle degeneration, fibrosis, and accumulations of debris and extracellular matrix.

51201 Radiation injury in the neonatal canine kidney. II. Quantitative morphology. Eisenbrandt, D.L.; Phemister, R.D. (Colorado State Univ., Fort Collins). *Lab. Invest.;* **38**: No. 3, 225-231(Mar 1978).

Quantitative morphology was used to investigate injury induced in the developing canine kidney by ionizing radiation. Irradiation at 2 days of age destroyed nephrogenic tissue in the outer renal cortex and significantly reduced kidney weight and volume through 70 days of age. However, as early as 14 days of age and continuing through 200 days of age, hypertrophy was demonstrated in the surviving middle and inner cortical nephrons of these kidneys. Both

corpuscular and tubular components of the nephrons grew at an accelerated rate as compared to controls. The corpuscular volume per nephron increased 559 percent in irradiated dogs and only 249 percent in controls from 14 to 200 days of age. The tubular volume per nephron increased 519 percent in irradiated dogs and 303 percent in controls during the same period. As a result of the compensatory growth in individual nephrons, the kidneys of irradiated dogs at 200 days of age were as large as the controls when compared on the basis of body weight. The extensive hypertrophy is associated with accelerated development of intercapillary glomerulosclerosis in dogs irradiated around the time of birth.

51202 Carcinoma of the prostate in irradiated parabiotic rats. Brown, C.E.; Warren, S. (Cancer Research Inst., Boston). *Cancer Res.;* **38**: No. 1, 159-162(Jan 1978).

Twelve hundred fifty-two pairs of male NEDH rats were parabiosed, one partner received a single dose of 1000 R x-radiation, and the other rat was shielded with lead. Eleven hundred twenty pairs survived over 200 days and constitute the basis of this report. Twenty-five of the irradiated partners developed malignant tumors of the prostate, 19 of which were adenocarcinomas. One adenocarcinoma appeared in the shielded partners and one in a control group of 586 parabiosed and single rats. The long-term effect of a single dose of 1000 R whole-body x-radiation is weakly carcinogenic for the rat prostate.

51203 Radioprotection of immunologically reactive T lymphocytes by WR-2721. Harris, J.W.; Meneses, J.J. (Univ. of California, San Francisco). *Int. J. Radiat. Oncol., Biol. Phys.;* **4**: No. 5/6, 437-440(1978).

We examined the ability of S-2-(3-aminopropylamino) ethyl phosphorothioic acid (WR-2721) to protect those splenic T lymphocytes that respond to alloantigen in mixed leukocyte culture by differentiating into immunologically specific cytolytic T lymphocytes (CTL). Injection of WR-2721 (400 mg/kg) 20 min before whole-body x irradiation protected viable-cell recovery and CTL activity, both measured on day 4 of culture. The dose-modifying factor (DMF) for viable-cell recovery was 1.6 (at 10% survival) and that for CTL activity was 1.54 or 1.69, depending on whether the ratio of the slopes or the actual activities at 10% survival were compared. Full protection was obtained 10 min after injection of the drug, and a high degree of protection persisted for at least 90 min. Our results indicate that WR-2721 provides a significant degree of protection to cells of the immune system that are significant in tumor suppression and suggest that the compound may prevent or moderate the immunosuppression that follows radiation therapy.

51204 Dynamics of changes in potential of hepatic mitochondria in the course of radiation sickness in rats. Fomenko, B.S.; Kamynin, A.N.; Elfimova, I.A.; Akoev, I.G. (Inst. of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 17-21(1978).

Translated from Radiobiologiya: 18: No. 1, 16-19(1978).

It was shown, on liver mitochondria of rats exposed to 800 rad radiation, that the potential, $H^+/0$ coefficient diminished and there was deregulation of mitochondria, against a background of activation of the mechanism of generation of potential, i.e., the electron transport chain within the first 12 h of radiation sickness. At this time, the rate of ATP synthesis was virtually the same as in the control. The next phase of decreased potential, $H^+/0$ ratio and deregulation of mitochondria was referable to the 1st to 3d postradiation days, and there was also inactivation of mitochondrial respiration.

51205 Distinctions referable to blood clotting and fibrinolysis in response to exposure to gamma radiation at high altitudes. Daniyarov, S.B.; Prizhivoit, G.N.; Moldotashev, B.U.; Rachkov, A.G. (Kirgiz State Medical Inst., Frunze, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 29-35(1978).

Translated from Radiobiologiya: 18: No. 1, 26-31(1978).

In experiments on dogs, it was shown that, at high altitude (3200 m), exposure to 400 rad γ radiation does not induce development of the hemorrhagic syndrome, and this is attributable to resistance of thrombocytopoiesis and the fibrin-fibrinolysis system, the proportion of components of which becomes established at a different level during the period of adaptation to high altitudes.

51206 Restoration of cellularity of various regions of lymph node cortex following total-body and partial irradiation. Pozharisskaya, T.D.; Lavrent'eva, I.I. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 59-64(1978).

Translated from Radiobiologiya: 18: No. 1, 51-55(1978).

A study was made of recovery of the cortex of lymph nodes of CC57W mice following total-body and partial irradiation. Determination was made of the number of cells per field, proportion of different types of cells per 1000 cellular elements, and number and type of cells capable of DNA synthesis. It was demonstrated that two cortical zones, the external layer and paracortical zone, react differently to radiation.

51207 Structural disorganization of rat cerebellar cortex induced by exposure to gamma radiation at the differentiation stage. Korogodin, V.I.; Korogodina, Yu.V. (All-Union Scientific Research Inst. of Genetics and Breeding of Industrial Microorganisms, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 65-69(1978).

Translated from Radiobiologiya: 18: No. 1, 56-59(1978).

Five-day-old Wistar rats were exposed to different doses of ^{60}Co γ rays and then sacrificed 30 days later; then determination was made of location of Purkinje cells on histological preparations of cerebellar cortex. It was shown that the extent of disorganization of location of Purkinje cells in the cerebellar cortex of animals that survived exposure to radiation at an early age increases rapidly with increase in radiation dosage, tending toward a maximum at the minimum absolutely lethal dosage. The progressive disorganization of Purkinje cells is associated with a decrease in weight of the cerebellum and impairment of some electrophysiological parameters.

51208 Distinctions in manifestation of the hemorrhagic syndrome related to chronic, long-term and acute irradiation. Arlashchenko, N.I.; Gorlov, V.G.; Maksimova, E.N. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 70-76(1978).

Translated from Radiobiologiya: 18: No. 1, 60-65(1978).

Two phenomena, decrease in strength of the vascular wall and decreased amount of thrombocytes in blood, must coincide for manifestation of the hemorrhagic syndrome. Either almost simultaneous injury to the vascular wall and thrombocyte function (with acute irradiation) or dissociation of these two processes (with long-term irradiation) may be observed, depending on the radiation dose. Chronic exposure at low (subliminal) dose rates does not elicit hemorrhagic manifestations or death of rats due to pathological bleeding.

51209 Production of normal human antitissular antibodies and evaluation of their efficacy on experimental radiation sickness in mice. Klemparskaya, N.N.; Golosova, T.V.; Shal'nova, G.A.; Murashova, N.S.; Ulanova, A.M.; Kuz'mina, T.D.; Makarova, E.M.; Lukovkina, E.N. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 77-82(1978).

Translated from Radiobiologiya: 18: No. 1, 66-70(1978).

The globulin fraction of human blood plasma enriched with autoantibodies increases significantly the radioresistance of white mice, especially when given preventively. It was established that there are four types of donor reactions to autohemostimulation. Primary single autohemostimulation should be used to obtain a globulin preparation with antitissular antibodies. There was demonstration of development of tolerance to repeated administration of autologous blood, as manifested by the lack of elevation of level of antitissular antibodies in blood within the first few hours after this procedure.

51210 Indicators of radioresistance modified by radioprotective agents report 1. ΔpO_2 as indicator of degree of mexamine-induced enhancement of radioresistance of rat bone marrow. Rozhdestvenskii, L.M.; Nikolaeva, S.I. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 91-97(1978).

Translated from Radiobiologiya: 18: No. 1, 78-83(1978).

The indicator approach to evaluation of effects of radioprotective agents is substantiated. A correlation was obtained between hypoxic and radioprotective effects of mexamine, given 5 min prior to irradiation, in rat bone marrow cells in vivo. An evaluation was made of both mean effectiveness of varying degrees of hypoxia and effectiveness in an individual animal on the basis of the DMF criterion.

51211 Postradiation changes in the system of adenylic acid synthesis in rat erythrocytes. Nikol'skaya, E.V.; Romantsev, E.F.; Filippovich, I.V. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 105-108(1978).

Translated from Radiobiologiya; 18: No. 1, 89-92(1978).

A study was made of synthesis of adenylic nucleotides in rat erythrocytes after exposing the animals to 800 R radiation. A decline in rate of synthesis was demonstrated, according to incorporation of 8-^{14}C-adenine in the fraction of adenylic acids, constituting 50% of the control level after 8 days. It was shown that the cause of this phenomenon is not an increased exit of cofactors or protein molecules of enzymes from irradiated cells into plasma.

51212 Effect of heterologous DNA on repair processes in the mucosa of the rat and mouse small intestine in the presence of the intestinal radiation syndrome. Kudryavtsev, V.D.; Gumenyuk, L.I.; Tsygankov, A.P. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 109-113(1978).

Translated from Radiobiologiya; 18: No. 1, 92-95(1978).

The gastrointestinal syndrome develops in most animal species with exposure to total-body radiation in doses of 1000 R or

higher, with which, according to some data, no beneficial effect of DNA preparations on animal survival is observed. At the same time, bearing in mind the high capacity of epithelial cells of the intestine for repair of radiation lesions, one would expect that DNA would have a beneficial effect on recovery processes in the intestine, even with superlethal doses of radiation, and that it would thereby alleviate the course of the intestinal radiation syndrome. There is no agreement on this score. According to some data, administration of exogenous DNA to rats exposed to 900 and 1600 R radiation extended life expectancy, caused an increase in number of epithelial cells in the duodenum, and enhanced mitotic activity of cryptal cells. The findings of other authors indicate that there is no beneficial effect or even an adverse effect of DNA on development of the intestinal syndrome. In order to shed more light on this issue, experiments on rats and mice were conducted to investigate the effect of a single dose of exogenous DNA given at different postradiation times on repair processes in the mucosa of the small intestine and life expectancy in the presence of the intestinal syndrome.

51213 Enzymatic activity of rat integument under the combined effect of external beta radiation and heat. Matyushichev, V.B.; Tarakhin, V.R.; Shamratova, V.G. (Leningrad State Univ.). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 114-118(1978).

Translated from Radiobiologiya; 18: No. 1, 96-99(1978).

It is interesting to investigate the manifestations of combined radiation lesions induced by external β irradiation of the organism at high ambient temperature in view of the fact that such forms of extreme factors are encountered in some occupations. Evaluation of changes in some biochemical indices, including activity of tissular enzymes, is an important factor in studies of levels of various parameters characterizing the postradiation condition of the object under study. However, there are no data in the literature as yet concerning the behavior of enzymatic systems exposed to beta and thermal loads. For this reason, our objective here was to analyze the fluctuations in activity of two key enzymes of energy metabolism, ATPase and creatine kinase, in response to external β irradiation (^{85}Kr) of an organism in a state of heat stress. We selected integumental tissue as the activity substrate due to the low penetration of ^{85}Kr β particles.

51214 Changes in levels of prostaglandinoid compounds in the mouse liver and spleen under the influence of ionizing radiation. Pryanishnikova, E.N.; Zhulanova, Z.I.; Romantsev, E.F. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 124-128(1978).

Translated from Radiobiologiya; 18: No. 1, 104-106(1978).

A considerable number of studies has been published that deal with the biochemical mechanism of action of a new class of biologically active compounds, prostaglandins. It was established that they influence membrane-bound enzymes that regulate the ATP level in the cell and, in particular, activity of adenylate cyclase, phosphodiesterase, and ATPase. Various extreme factors (cold stress, electroshock, administration of a number of chemical and pharmacologically active agents, nerve impulses) increase the rate of prostaglandin synthesis and lead to discharge thereof in the blood stream. There are virtually no data in the literature concerning the effect of ionizing radiation on prostaglandin levels in animal tissues and organs. A study has been made of the effect of radiation on the correlation between prostaglandins and catecholamines, and it was shown that ionizing radiation, in doses of 500 and 750 rad, elicits changes in levels of both catecholamines and prostaglandins E_1 and F_2/sub α/ in the rat liver and brain for 1 to 18 days after irradiation. The objective of this work was to investigate the effect of irradiation of mice on levels of prostaglandinoid compounds (PGC—fraction of polar lipids with the pharmacological properties of prostaglandins which contains, in addition to prostaglandins, their derivatives and analogues) in the mouse liver and spleen during the first 24 h after irradiation.

51215 Influence of DNA preparations on the mutagenic effect of radiation on germ cells of male mice. Ramaiya, L.K.; Pomerantseva, M.D. (Inst. of General Genetics, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 129-132(1978).

Translated from Radiobiologiya; 18: No. 1, 107-110(1978).

It was recently demonstrated that therapeutic and preventive administration of DNA preparations is very effective as biological protection against the lethal effects of diverse forms of radiation on cells and the organism of an animal as a whole. The protective effect of DNA against genetic disturbances induced by radiation has been less studied. We did not encounter any data concerning the protective effect of DNA against radiation mutations in mammalian germ cells in the available literature. Protection of germ cells against the mutagenic effect of radiation is a complex problem, since many agents that provide protection against the lethal effect of radiation do not do so with respect to mutations in germ cells. For this reason, the objective of our work was to determine the degree of efficacy of DNA in protecting mammalian germ cells against dominant lethal mutations and reciprocal translocations induced by radiation.

51216 Influence of thymocytes on hemopoiesis following nonuniform irradiation. Zyablitskii, V.M.; Maslennikova, R.L.; Zhavoronkov, L.P. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 138-140(1978).

Translated from Radiobiologiya; 18: No. 1, 114-116(1978).

In the last few years, it was demonstrated that the thymus is involved in regulation of hemopoiesis, stimulation of hemopoiesis in irradiated animals, and thymocyte cooperation with injured stem cells, which aids in healing of the latter. The bone marrow syndrome develops in a special way in the case of nonuniform irradiation due to the presence of intact or mildly injured areas of hemopoietic tissue that deliver stem cells in the nonirradiated organism. It is a pressing task to find the ways and means of stimulating hemopoiesis and activating the process of stem cell migration, as one of the elements in the mechanism of recovery of hemopoiesis. The objective of our work was to investigate the influence of the thymus on stem cells of mice exposed to nonuniform radiation.

51217 Some mechanisms of impaired absorption in the rat small intestine following total-body gamma irradiation. Nesterenko, V.S.; Piskarev, A.V.; Sushkevich, L.N. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 141-145(1978).

Translated from Radiobiologiya; 18: No. 1, 116-119(1978).

Impairment of the process of absorption of various substances in the small intestine of irradiated animals and man is an important factor in the pathogenesis of radiation lesion to the organism. However, in most studies, data are submitted on impairment of the process of absorption of some nutritional ingredient, and there is no information about impaired absorption of the entire set of main components of nutrition at different postradiation times; many of the works are of a descriptive nature and do not determine the role of trophic changes in the pathogenesis of postradiation disturbances referable to absorption. In view of the foregoing, it was deemed necessary to study absorption of the main nutritional components—proteins, fats, carbohydrates, and salts in irradiated animals, as well as to determine the significance of disturbances referable to some stages of the digestive and transport systems in the genesis of radiation-induced absorption disorders.

51218 Mixture of chemical protective agents used to prevent radiation-induced testicular lesions. Mamina, V.P.; Tregubenko, I.P. (Inst. of Ecology of Plants and Animals, Sverdlovsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 150-153(1978).

Translated from Radiobiologiya; 18: No. 1, 123-127(1978).

The spermatogenic epithelium is one of the most radiosensitive tissues of the organism. It is known that ionizing radiation inhibits reproduction and development of germ cells, inducing structural and functional disturbances and chromosomal aberrations in them, as well as destruction. The use of radioprotective agents is one possibility for preventing or attenuating the reaction to radiation. The protective agents known for their high efficacy in protecting the body or some vital tissues were found to be considerably less effective with regard to germ cells.

51219 Reaction of vascular wall endothelium to ionizing radiation. Tkachenko, Z.Ya.; Demidova, G.G.; Chebotarev, E.E. (Inst. of Oncological Problems, Kiev). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 154-158(1978).

Translated from Radiobiologiya; 18: No. 1, 127-131(1978).

Much significance is attributed to vascular wall injury and related hemorrhagic syndrome in development of radiation pathology. Authors relate changes in nerve tissue to injury to the vascular system. In the course of studies of injuries to nervous structures of the solar plexus and intramural plexi of the stomach and ileocecal region, we paid attention to significant changes occurring in the vessels of these regions, and this, as we know, aggravates hypoxia to which nervous tissue is so sensitive. In our analysis of the morphological reactions to radiation, which we observed in vessels, we submit these data on both the microscopic and submicroscopic levels, in view of the fact that there is not enough information on this score in the literature.

51220 Comparative study of interphase cell death and severity of bone marrow aplasia in bank voles of the Moscow suburbs and C57B1 mice under the influence of ionizing radiation. Samokhvalova, N.S.; Popova, M.F.; Domareva, O.P.; Suvorova, E.A. (Inst. of Evolutionary Morphology and Ecology of Animals, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 169-172(1978).

Translated from Radiobiologiya; 18: No. 1, 139-142(1978).

Interphase of bone marrow cells, which may reach significant dimensions according to some researchers, is one of the criteria of radiation lesion to the marrow. The method of estimating the total number of nuclear cells in animal bone marrow also makes it possible to gain an idea about the severity of tissue destruction. The objective of this work was to study interphase cell death and severity of

aplasia in the bone marrow of bank voles of the Moscow suburbs and C57B1 mice after exposing these animals to x rays.

51221 (DOE-tr—4/6) **Radiobiology.** Translation of *Radiobiologiya;* **17**: No. 6, 803-960(1977). 181p. Dep. NTIS, PC A09/MF A01.

Available from NTIS for $45.00 per year (six issues) as NTISUB/C/120-006.

Separate abstracts were prepared for the 32 papers included in this English translation of Radiobiology. (HLW)

51222 Chemoluminescence of α- and β-lipoproteins of blood plasma of rats exposed to fast neutrons. Serkiz, Ya.I.; Kotun, T.V.; Ryabova, E.Z.; Chebotarev, E.E. (Inst. of Oncological Problems, Kiev). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 1-5(1977).

Translated from Radiobiologiya: 17: No. 6, 803-806(1977).

A study was made of hydrogen peroxide induced chemoluminescence of α- and β-lipoproteins of blood plasma of albino rats exposed to fast neutrons. A correlation was demonstrated between parameters of luminescence kinetics and age of animals, as well as postradiation time (3, 6, 9 and 12 months). Appearance of tumors following irradiation is also associated with a change in luminescence characteristics.

51223 DNA content of radiosensitive organs of albino rats exposed to radiation at high altitude and following adaptation to hypoxia in a pressure chamber. Guseinov, F.T.; Egorov, I.A.; Komolova, G.S.; Shafirkin, A.V.; Moldotashev, B.U.; Gladilin, K.L. (Inst. of Biochemistry, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 20-25(1977).

Translated from Radiobiologiya: 17: No. 6, 818-822(1977).

Pre-exposure of rats to hypoxia attenuates the postradiation decrease in DNA content (μg/mg dry tissue or protein) of the spleen, bone marrow and thymus in the destructive period of radiation sickness. In the postradiation recovery period, the levels of DNA in the animal organs examined, after exposure to hypoxia, were higher than in the organs of the corresponding nonirradiated control animals. However, this effect depends on the distinctions of the organ and exposure to hypoxia.

51224 Comparative study of radioprotective activity and mechanism of action of 2-mercaptopropionylglycine and β-mercaptoethylamine. Konstantinova, M.M.; Revez, L. (Inst. of Developmental Biology, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 45-50(1977).

Translated from Radiobiologiya: 17: No. 6, 839-843(1977).

As a result of studying the radioprotective activity of 2-mercaptopropionylglycine (MPG), it was established that this compound has marked radioprotective activity in mice and Ehrlich ascites carcinoma cells in vitro. The mechanism of radioprotective action of MPG on animals, as that of other sulfhydryl compounds (MEA--cysteamine), is not related to the oxygen effect, but to the influence thereof on the level of endogenous thiols. Analysis of the mechanism of radioprotective effects of MPG and MEA, performed on cells, revealed that the increase in radioresistance induced by these agents is determined by an increase in endogenous SH glutathione elicited by administration of protective agents, rather than the presence of such agents in cells.

51225 Age-related changes in radiosensitivity of animals and critical cell systems. Report 1. Survival after exposure to bone marrow dose range of radiation and general characteristics of the CFU pool. Konoplyannikova, O.A.; Konoplyannikov, A.G. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 51-55(1977).

Translated from Radiobiologiya: 17: No. 6, 844-848(1977).

Similar age-related changes are observed in three strains of mice with regard to general radiosensitivity as tested by the level of LD/sub 50/30/. These changes cannot be unequivocally related to such factors as growth rate in different periods of life or changes in cellularity of hemopoietic tissues, and amount of stem type cells in them.

51226 Changes in hemopoiesis and survival of mice exposed to long-term radiation. Kalina, I.; Praslicka, M. (Safarik Univ., Kosice, Czech.). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 56-62(1977).

Translated from Radiobiologiya: 17: No. 6, 849-854(1977).

A study was made of the change in colony-forming capacity and total number of bone marrow cells, amount of cellular elements in peripheral blood and survival of continuously irradiated mice (dose rates of 25, 50 and 80 R/day). At dose rates of 25 and 50 R/day, after an initial decline of CFU [colony-forming units], bone marrow cells, blood lymphocytes and thrombocytes, there was stabilization; there was no appreciable change in amount of erythrocytes and granulocytes. There was general disruption of hemopoiesis with a dose of 80 R/day. Mean survival time constituted 132.8 days at a dose rate of 50 R/day and 43.3 days at the rate of 80 R/day.

51227 Postradiation recovery of skeletal muscles of animals of different ages. Popova, M.F.; Bulyakova, N.V. (Inst. of Evolutionary Morphology and Ecology of Animals, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 63-68(1977).

Translated from Radiobiologiya: 17: No. 6, 855-860(1977).

Significant postradiation repair, as indicated by restoration of the capacity of skeletal muscles for posttraumatic regeneration, takes place in such muscles of young rats (particularly at the age of 3 to 4 weeks) within 1 month after local irradiation in a dosage of 2000 R. The regenerative capacity is not restored in old rats in muscles exposed to the same dose of radiation. Probably, the faster processes of postradiation recovery in muscles of young animals are attributable to their more active metabolism.

51228 Effects of neutrons on golden hamsters as related to different contributions of gamma radiation to the total dosage. Saikova, V.A.; Sverdlov, A.G.; Martynchik, Yu.F.; Postnikov, L.N.; Yarkovets, A.G. (Inst. of Nuclear Physics, Leningrad). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 69-73(1977).

Translated from Radiobiologiya: 17: No. 6, 861-864(1977).

It was demonstrated that development of the hemorrhagic syndrome with multiple effusions of blood, mainly into the stomach, cecum and lungs, without any manifestations of the intestinal syndrome, is inherent in gold hamsters exposed to neutrons and x-rays. The LD/sub 50/30/ of mixed γ-neutron radiation, with a 24 percent and a 76 percent gamma component in the total radiation dose, constituted 206 +- 15 rad and 530 +- 45 rad, respectively, and that of x-rays, 600 +- 52 R. The RBE of neutrons, according to LD/sub 50/30/, constituted 3.43 +- 0.44 and 1.45 +- 0.33 (24 percent and 76 percent γ-component in the total dose).

51229 Radiobiological parameters of π-mesons. Vainson, A.A.; Shmakova, N.L.; Meshcherikova, V.V.; Fadeeva, T.A.; Yarmonenko, S.P. (Oncological Research Center, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 85-93(1977).

Translated from Radiobiologiya: 17: No. 6, 874-880(1977).

Studies were made of relative biological effectiveness and oxygen enhancement ratio of the π-meson beam at a dose rate of 2 to 4 rad/min at Bragg peak. The relative biological effectiveness of π-mesons constitutes 1.7 according to Chinese hamster cell survival, as compared to γ-radiation, and 1.5 to 1.8 according to induction of chromosomal aberrations in mouse bone marrow. The oxygen enhancement ratio for π-mesons according to survival of Chinese hamster cells and induction of aberrations constitutes 2.1 and 2.15, versus 2.7 and 2.5 for γ- and x-radiation, respectively, in each test. The authors discuss the advantages of π-minus mesons over the usual forms of radiation used in radiation therapy.

51230 Effect of preradiation on change in concentration of free radicals in albino rat tissues induced by acute hypoxia and hyperoxia. Fedorchenko, V.I.; Kulyabko, P.N.; Chebotarev, E.E. (Inst. of Oncological Problems, Kiev). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 109-112(1977).

Translated from Radiobiologiya: 17: No. 6, 894-897(1977).

Rats were x-irradiated and then exposed to acute hypoxia or hyperoxia at intervals. Tissue samples were analyzed for free radicals. No appreciable changes were observed in free radical activity of most tissues of irradiated animals exposed to hypoxia or hyperoxia. X radiation induced significant impairment in tissue respiration as manifested by a change in the nature of reactions of the organism referable to redox processes with exposure to hypoxia or hyperoxia. (HLW)

51231 Radioprotective effects of AET and mexamine on pentose cycle dehydrogenases. Gorelik, Yu.Ya.; Rusanov, A.M.; Krutovskikh, G.N.; Gornaeva, G.F. (Central Scientific Research Inst. of Roentgenology and Radiology, Leningrad). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 113-116(1977).

Translated from Radiobiologiya: 17: No. 6, 897-900(1977).

AET and mexamine were given intraperitoneally to guinea pigs and rats 15 min before whole-body x irradiation. The activity of pentose cycle dehydrogenase was assayed 4 days later in guinea pig erythrocytes and 8 days later in rat erythrocytes. The activity of glucose-6-phosphate dehydrogenase in rat bone marrow was studied 4 to 10 days after irradiation. AET and mexamine prevented depression of pentose cycle dehydrogenase in irradiated guinea pigs. In experiments with rats, mexamine had a more marked radioprotective effect while AET did not have a radioprotective effect. The radioprotective effect of AET and mexamine on glucose-6-phosphate dehydrogenase was also demonstrated in experiments with bone marrow from irradiated rats. (HLW)

51232 Postradiation decrease in shielding of phosphatidyl ethanolamine in erythrocyte membranes. Dovgii, I.E.; Fomenko, B.S.; Akoev, I.G. (Inst. of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 117-119(1977).

Translated from Radiobiologiya; 17: No. 6, 901-903(1977).

The effect of radiation on accessibility of phosphatidyl ethanolamine (PEA) of erythrocyte membranes to sulfonic acid 2,4,6-trinitrobenzene (TNBS) was tested. Erythrocytes were obtained

from rats 1 h after exposure to gamma radiation and accessibility of erythrocyte membrane PEA to TNBS was determined. These investigations demonstrated a change in lipid-protein interactions in irradiated erythrocyte membranes. This could lead to a change in conditions under which membrane-dependent enzymes function, for example, a deviation from normal cooperation thereof. Another important consequence of a change in protein-shielding of phospholipids could be an increase in their accessibility to phospholipases, as is the case when membranes are treated with detergents. Greater vulnerability of phospholipids could lead to faster enzymatic dissociation thereof and, consequently, to a change in the functional characteristics of membranes, for example, increased permeability for ions. (HLW)

51233 Yield of aberrant anaphases in loach embryos as function of dose rate of chronic irradiation. Pechkurenkov, V.L. (All-Union Scientific Research Inst. of Pond Fisheries, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 125-128(1977).

Translated from Radiobiologiya; 17: No. 6, 906-909(1977).

Fertilized eggs and embryos of the loach (Misgurnus fossilis) were exposed to chronic gamma irradiation and EDTA was added to some experiments. The mitotic index and quantity of aberrant anaphases were determined after irradiation at various stages of development. The yield of aberrant anaphases in the case of low dose rates was determined more by correlation between effectiveness of repair systems and amount of primary lesions sustained by cell chromosomes per unit time than by rate of cell division. (HLW)

51234 Changes in number of goblet cells in small intestine epithelium of irradiated and mercaptoethylamine-protected mice. Rasina, L.N.; Semenov, D.I.; Tregubenko, I.P. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 129-132(1977).

Translated from Radiobiologiya; 17: No. 6, 910-913(1977).

Mice were exposed to whole-body gamma radiation and killed at intervals up to 120 days later. Segments of the duodenum were prepared for microscopic examination. Epithelial cells and goblet cells were counted and compared with the number of cells from mice treated with MEA in addition to radiation. Radiation reduced the number of epithelial and goblet cells and there was a marked decrease in the ratio of the latter. The decrease in goblet cells was less marked in mice protected with MEA. (HLW)

51235 Life expectancy of animals exposed to the combination of radiation and high temperature. Molotkov, O.V. (Smolensk State Medical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 133-135(1977).

Translated from Radiobiologiya; 17: No. 6, 913-915(1977).

Rats were exposed to a cumulative x radiation dose of 800 R and subjected to acute overheating in a special heat chamber for 35 min. Determinations were made on free and protein-bound corticosterone in peripheral blood and capacity of blood proteins to bind added corticosterone. Results showed that in overheated animals there was an increase in total corticosterone and an increase in plasma protein capacity to bind corticosterone. Life expectancy was reduced. (HLW)

51236 Changes in mouse body weight during natural and radiation-induced aging. Vershinina, S.F. (Central Scientific Research Inst. of Roentgenology and Radiology, Leningrad). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 139-141(1977).

Translated from Radiobiologiya; 17: No. 6, 918-920(1977).

Mice with an initial weight of 18 to 22 g were exposed to 400 R of x radiation. They were weighed daily for the first month and periodically thereafter. There was a 13 percent weight loss during the first 12 days following irradiation; however, from the 13th to the 30th day the rate of weight gain was 100 percent faster in irradiated animals than in controls. The dynamics of body weight of irradiated mice up to the sixth month can be described by an equation of linear regression. (HLW)

51237 Faster healing of local radiation lesions to the skin in experiments involving multiple preliminary exposure to ulraviolet radiation. Baraboi, V.A.; Isaenko, V.I.; Kirichinskii, B.R.; Pratsyuk, L.I. (Kiev Scientific Research Inst. of Roentgenology-Radiology and Oncology). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 142-146(1977).

Translated from Radiobiologiya; 17: No. 6, 920-923(1977).

Localized lesions of the skin were produced in rats by exposure to x radiation. Rats were exposed to uv radiation at different intervals before and after exposure to x radiation. Faster healing of radiation lesions was observed in all experiments following the use of uv radiation. A decrease in the number of exposures of uv and particularly a reduction of the interval between the start of uv and x radiation diminished the prophylactic efficiency of uv radiation. (HLW)

51238 Dosimetric criteria of canine mortality following total-body nonuniform irradiation. Gozenbuk, V.L.; Keirim-Markus, I.B. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 163-166(1977).

Translated from Radiobiologiya; 17: No. 6, 936-938(1977).

Results of previous experiments involving nonuniform exposure of dogs to gamma radiation were used for analysis of dosimetric criteria. The equivalent dose characterizes the probability of survival after sustaining the bone marrow form of radiation lesion. In the equivalent dose formula, the function P(D) is hemopoietic activity as a function of dosage. With doses up to 1200 rad, involvement of organs or tissues other than the hematopoietic system is not required to explain radiation death. Survival was appreciably increased by minor nonuniformity of irradiation. The scatter values of LD_{50} observed by different authors under comparable irradiation conditions can be attributed to minor differences in dose distribution in bone marrow. (HLW)

51239 Methemoglobin-producing effect and its role in the mechanism of action of some radioprotective agents in the benzo-2,1,3-thiadiazole class. Vladimirov, V.G.; Chigareva, N.G.; Belen'kaya, I.A.; Strel'nikov, Yu.E. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 32-38(1977).

Translated from Radiobiologiya: 17: No. 6, 828-833(1977).

A study was made of some derivatives of benzo-2,1,3-thiadiazole with regard to their capacity to form methemoglobin in blood. It was demonstrated that, 30 min after intraperitoneal administration of radioprotective doses of such agents to mice, the blood methemoglobin level does not exceed 5 percent. With administration to mice of 4-aminobenzo-2,1,3-thiadiazole in a toxic dose 14 percent methemoglobin is produced in blood. In dogs, almost 50 percent methemoglobin is formed in blood after oral intake of 4-aminobenzo-2,1,3-thiadiazole; this is a level that can provide for the radioprotective action of this compound. Using agents that prevent oxidation of hemoglobin to methemoglobin (2-methoxy-9-phenazine sulfate and isonicotinic acid hydrazide), it was demonstrated that the methemoglobin formed in mouse blood does not play a leading role in manifestation of the radioprotective action and toxic properties of 4-aminobenzo-2,1,3-thiadiazole.

INVERTEBRATES

51240 Radiomutability of specific loci and mutation isoalleles in the Drosophila: facts and fantasies. Aleksandrov, I.D. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 104-108(1977).

Translated from Radiobiologiya: 17: No. 6, 890-894(1977).

Some topics discussed are as follows: criteria of mutability; analysis of the nature and incidence of mutation of specific loci in different genotypes; incidence of visible mutations; intracellular mechanisms of divergence of mutability; and comparative radiomutability of yellow and white alleles in different genotypes of Drosophila. (HLW)

BASIC STUDIES

51241 Gamma radiation used to stimulate hatching of Artemia salina larvae. Ivanovskii, Yu.A.; Mitrofanov, Yu.A. (Inst. of Marine Biology, Vladivostok, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 164-168(1978).

Translated from Radiobiologiya; 18: No. 1, 135-138(1978).

Most studies dealing with the stimulating effect of radiation have been conducted on plant objects. There are few studies on animals in this respect. Burlakova et al. observed stimulation of hatching of larvae of the A. salina branchiopod by exposure of dry and wet eggs of this crustacean to x rays. In this work, our objective was to test the effect of γ radiation on hatching of A. salina eggs soaked in salt water varying in salinity and exposed to radiation. This was due to the fact that salinity is one of the most important environmental factors for aquatic organisms and changes therein make it possible to control the amount of A. salina larvae hatching from eggs, the rate of biosynthetic processes in which depends on the concentration of NaCl.

51242 Effect of x radiation on olfaction and behavior of codling moths (Laspeyresia pomonella L.). Pristavko, V.P.; Chaika, V.N. (Ukrainian Scientific Research Inst. of Plant Protection, Kiev). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 177-180(1978).

Translated from Radiobiologiya; 18: No. 1, 146-148(1978).

At the present time, genetic control of harmful insects is being performed by means of releasing artificially reproduced and sterilized males. They are sterilized with x- or γ-rays, and the selected doses lead to satisfactory sterilization but do not induce substantial injuries in systems involved in locomotion of the insects, search for females, and mating. This is not an easy task, particularly with regard to lepidoptera, when radiation in doses of dozens of krad elicits satisfactory lethality of sperm. Such doses have a substantial depressing effect on insects. It is difficult to find sterilization doses,

in particular, because of the lack of data on the effects of radiation on insect olfaction, which plays an important role in their reproductive activity. Previously, we used an electrophysiological method to evaluate olfaction of irradiated insects, and we demonstrated the depressing effect of x radiation. It is also known that radiation sterilization depresses insect flight and behavioral reactions to sexual attractants. The existing data are fragmentary and do not provide a complete enough picture of the effects of ionizing radiation on this aspect of vital functions of insects. Thus, we do not know how radiation dose rate and energy affect olfaction. In this work, we studied the effect of dosage, dose rate, and effective energy of x rays on olfaction, behavioral reaction to an attractant, and mobility of codling moths. This insect species is the most dangerous pest of orchards, and the method of sterilization by irradiation thereof is currently being intensively developed.

PEST CONTROL

REFER ALSO TO CITATION(S) 51242

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 51009

51243 (NVO—178, pp 621-690) **Nevada Applied Ecology Group model for estimating plutonium transport and dose to man.** Martin, W.E.; Bloom, S.G. (Battelle Columbus Labs., OH). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

A Standard Man is assumed to live in and obtain most of his food from a plutonium-contaminated area at the Nevada Test Site (NTS). A plutonium transport model, based on the results of other Nevada Applied Ecology Group plutonium studies, is used to estimate potential chronic rates of ^{239}Pu inhalation and ingestion as functions of the average concentration of ^{239}Pu (C/sub s/ = pCi/g) in the surface soil (0 to 5 cm depth) of the reference area. Assuming the transport system to be in steady state, the estimated inhalation and ingestion rates (pCi/day) are 0.002 C/sub s/, respectively. A dose estimation model based on parameters values recommended in publications of the International Commission on Radiological Protection is used to estimate organ burdens, accumulated doses, and dose commitments as functions of exposure time. Estimated doses (rems) due to chronic inhalation and ingestion of ^{239}Pu for 50 years at the rates indicated above are: thoracic lymph nodes, 0.610 C/sub s/; lungs, 0.026 C/sub s/; bone, 0.014 C/sub s/; liver, 0.009 C/sub s/; kidney, 0.003 C/sub s/; total body, 0.0007 C/sub s/; and gastrointestinal tract (lower large intestine), 0.0002 C/sub s/. Inhalation accounts for 100 percent of the estimated dose to lungs and thoracic lymph nodes and for about 95 percent of the estimated dose to bone, liver, kidney, and total body. Ingestion accounts for > 99 percent of the dose to the gastrointestinal tract. According to ICRP recommendations for individual members of the public, the dose rate to the lungs after 50 years' exposure should not exceed 1.5 rems/year. The plutonium transport and dose estimation model described in the report indicate that the average concentration of ^{239}Pu in the surface (0 to 5 cm) soils of contaminated areas at NTS which could result in a maximum dose rate of 1.5 rems/year to the lungs is approximately 2.8 nCi/g or about 140 μCi/m^2 for soils weighing 1.0 g/cm^3.

ANIMALS

REFER ALSO TO CITATION(S) 51221

51244 **Biological effects of autoantibody preparations on rats given tritium oxide.** Zhuravlev, V.F.; Shal'nova, G.A.; Klemparskaya, N.N.; Moskalev, Yu.I.; Kalyazina, N.S.; Kuz'mina, T.D.; Katsapov, I.S. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 83-90(1978).

Translated from Radiobiologiya: 18: No. 1, 71-77(1978).

Homologous globulin (in a dosage of 5 mg) containing normal autoantibodies increases rat survival both at the short and long terms after giving them tritium oxide in a dosage of 0.6 mCi/g. Mean life expectancy is 60 days longer for treated animals, as compared to the control. Administration of 5 mg globulin prolongs life expectancy of intact rats by 71 days, as compared to the biological control.

51245 **Dominant lethality among male rats given tritium (tritiated water).** Yagova, A.Kh.; Baev, I.A.; Bairakova, A.K. (Inst. of Roentgenology and Radiobiology, Sofia). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 146-149(1978).

Translated from Radiobiologiya; 18: No. 1, 120-123(1978).

The possibility of formation of tritium and its entering the human body in the case of thermonuclear explosion or operation of nuclear power plants makes it purposeful to determine the genetic risk related to this environmental factor. Such information can be obtained chiefly through experimentation. The somatic effects of incorporated tritium have been studied relatively well, whereas there are only a limited number of studies of the genetic sequelae of intake thereof by mammals. In this work, our objective was to determine the degree of genetic injury in rats, on the basis of the test for dominant lethal mutations, as related to the time after giving tritium and level of administered activity. The doses we used, 10 and 1 μCi/g body weight, correspond to 0.01 and 0.001 $LD_{50/30}$, respectively.

51246 **Effects of strontium-90 and metaphos on Cyprinus carpio.** Aleksan'yan, O.M.; Kosinova, N.R.; Krylova, T.M. (Azov Scientific Research Inst. of the Fishing Industry, Rostov-on-Don, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 159-163(1978).

Translated from Radiobiologiya; 18: No. 1, 131-134(1978).

Technological progress has resulted in the appearance in the biosphere of new toxic substances, including artificial radionuclides and toxic chemicals. Organochlorine and organophosphorus pesticides, as well as radioactive substances, are becoming a constantly active ecological factor in the oceans of the world. As a rule, several toxic factors affect organisms inhabiting a specific ecological niche at the same time. The reactions of the animals to the combined effect of pollutants may differ from those to each of them alone. The objective of this work was to investigate the separate and combined effects of one of the most radiotoxic β-emitters, strontium-90, and a contact insecticide with a wide spectrum of action, metaphos [(0,0-dimethyl-0-4-nitrophenyl) thiophosphate] on the scale carp (Cyprinus Carpio).

51247 **Primary effects of long-term administration of tritium oxide.** Kazbekova, D.A.; Tishchenko, G.S.; Katsapov, I.S. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 173-176(1978).

Translated from Radiobiologiya; 18: No. 1, 142-145(1978).

The extensive use of tritium in various branches of science and economy makes it necessary to submit it to comprehensive investigation. Most works deal with toxicology and kinetics of metabolism of this isotope. In recent years, an increasing number of studies is being published on evaluation of its biological effect. Most often the experiments involved single administration of the isotope. Yet there is considerable interest in investigations that record the biological effects of tritium under conditions that are as close as possible to actual situations, i.e., prolonged intake of the isotope in low doses via the natural routes. There are very few such works. We found no works at all dealing with the morphological signs of lesion in the case of chronic intake of low doses of tritium. Experiments were conducted on 50 female rats weighing 120 to 140 g, 12 of which served as a control; 14 were sacrificed on the 1st, 8th, 30th, and 120th days after administration of tritium, 3 to 5 animals at a time, and the others expired. For 6 months, the rats were given 3.22 μCi/g tritium oxide daily in their drinking water. The cumulative tissue dose received by the animals in 180 days constituted 666.8 rad. Morphological examination of the material revealed the most marked changes in endocrine and hemopoietic organs, as well as vessels, and the microcirculatory part of the vascular system was found to be the most altered.

51248 **Hemopoiesis in rats chronically exposed to tritium oxide.** Voronin, V.S.; Kirillova, E.N.; Uryadnitskaya, T.I. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 74-79(1977).

Translated from Radiobiologiya: 17: No. 6, 865-869(1977).

A study was made of the changes in quantity of formed elements of blood and bone marrow of rats in the course of 6 months of exposure to tritium oxide (HTO) in daily doses of 10, 1 and 0.1 μCi/g body weight. It was demonstrated that there is a correlation between severity and nature of blood changes and the radiation dosage. It was found that the safe dosage of HTO for rats is in the range of 0.025 to 0.053 Ci/g with the rate and duration of administration used by the authors.

PLANTS

REFER ALSO TO CITATION(S) 51221

51249 **Effect of strontium 89 on wheat.** Zuev, N.D.; Korneeva, N.V.; Ponomareva, R.P.; Teplyakov, I.G.; Savina, V.I. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 156-159(1977).

Translated from Radiobiologiya; 17: No. 6, 931-933(1977).

Wheat seeds were planted and experimental plots were contaminated with solutions of ^{89}Sr of different concentrations. Developing plants were examined for yield, sowing qualities of seeds, physiological changes, morphological changes, and mutations. Results are tabulated and discussed. (HLW)

NUCLIDE KINETICS AND TOXICOLOGY

REFER ALSO TO CITATION(S) 50975

MAN

REFER ALSO TO CITATION(S) 51286

51250 (LBL—7407) **Effect of transport in distribution of radioions and radiolabeled metabolites.** Yano, Y. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 22 Dec 1977. Contract W-7405-ENG-48. 26p. (CONF-780551—1). Dep. NTIS, PC A03/MF A01.

From 1. symposium on radiopharmacology; Innsbruck, Austria (21 May 1978).

The following topics are discussed: route of administration; carrier effects and complexed or ionic tracers; membrane permeability, extracellular and intracellular concentrations; enzyme and hormonal stimulation or depression and the metabolic state; neoplasia and transport; and carrier for radiopharmaceutical binding to membrane or protein sites. Some radioisotopes considered are /sup 99m/Tc, ^{65}Zn, ^{62}Zn, ^{14}C and ^{111}In. (HLW)

51251 (RFP—2777) **System of high-purity germanium detectors for the detection and measurement of inhaled radionuclides.** Falk, R.B.; Tyree, W.H.; Wood, C.B.; Lagerquist, C.R. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 1978. Contract EY-76-C-04-3533. 21p. (CONF-780612—5). Dep. NTIS, PC A02/MF A01.

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

A system of eight high-purity germanium detectors mounted, four each, as arrays on two downward-looking cryostats is described. This system is designed to measure photons emitted by inhaled radionuclides and is efficient for photon energies between 10 keV and 200 keV. In routine operation since October 1976, the system is used mainly to detect and measure inhaled plutonium and americium. Each of the eight detectors has a surface area of 10 cm^2 and a resolution of 650 eV full-width half-maximum or better at 60 keV. This excellent resolution means that the photopeak can be placed in a narrow portion (about 1 keV) of the background energy spectrum. Consequences of this feature are: (1) the subject background count rate for a given photopeak is low (between 0.025 and 0.035 counts/min per cm^2 detector surface area for a 1-keV band in the range of 15 to 100 keV); (2) the subject background can be well estimated from counts in the energy spectrum a few keV above the photopeak of interest; (3) baseline resolution can be obtained for photons separated by as little as 1.5 keV in energy; and (4) identification of unknown or unexpected radionuclides can be accomplished with good accuracy. Applications and capabilities of the system are discussed. The current application is for the measurement of plutonium via the measurement of the 59.54-keV gamma from ^{241}Am. The measurement of L x-rays from the decay of plutonium is also discussed.

51252 (UCRL—80340) **New developments in ultrasonic imaging of the chest and other body organs.** Campbell, G.W.; Anderson, A.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Nov 1977. Contract W-7405-ENG-48. 4p. (CONF-780612—4). Dep. NTIS, PC A02/MF A01.

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

The accurate measurement of transuranic elements deposited in the lung is a complex task. One of the problems is measuring uranium-L x-rays associated with plutonium passing through the chest of an accidentally exposed subject. Because the normal human chest-wall thickness varies from about 1 to 4.5 cm, it is important that an accurate determination be made for every person counted for plutonium or for other heavy elements with similar emissions. An ultrasonic B-scanning system (brightness modulated time-base) was developed for defining the structure within the body. Computer programs were written to determine the distance between the lung and chest-wall interface and the outer surface of the chest wall at several points on each scan. These points are exponentially averaged to obtain an average chest-wall thickness that is used, with other information, to derive a calibration factor for plutonium in the subject. It is also combined with the counting data to obtain the plutonium lung burden. Since photon transmission characteristics differ in fat and soft tissue, assessing the fat content is important and can provide a correction factor for counter sensitivity when viewing various organs. The main advantage of the B-scanning and three-dimensional systems are discussed.

ANIMALS

REFER ALSO TO CITATION(S) 51029, 51030, 51031, 51035, 51069, 51129, 51250, 51331

51253 (NVO—178, pp 419-433) **Application of the artificial rumen and simulated bovine gastrointestinal fluids procedure in the study of the bioavailability of transuranics.** Barth, J. (Environmental Protection Agency, Las Vegas, NV). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

An artificial rumen and simulated abomasal and intestinal fluids procedure was used to study the alimentary availability of plutonium-238. When plutonium-238 was administered as plutonium nitrate, 10.1% remained soluble following the artificial rumen incubation period and 15.3% following the abomasal period; 30.1% and 32.7% remained soluble when the fluid was held at pH 4 and 5, respectively, during the duodenal phase. The solubility increased to 60.1% following the addition of bile and enzymes with adjustment of the pH to 6 to simulate the jejunum. The increase in plutonium solubility in the simulated jejunal fluid was found to be due to the presence of bile. Plutonium administered as a citrate-buffered plutonium solution was 9.0% soluble following the rumen incubation period, 13.1% following the abomasal period, and 22.5% and 24.8% when held at pH 4 and 5, respectively, in the duodenal phase. The solubility increased to 59.6% following the addition of bile and enzymes with adjustment of the pH to 6. Plutonium administered as 0.06-μm plutonium dioxide spheres was 1.5% soluble following the rumen incubation period, 2.3% following the abomasal period, and 3.6% and 3.9% when held at pH 4 and 5, respectively, in the duodenal phase. Solubility increased to 7.4% following the addition of bile and enzymes with adjustment of the pH to 6. Rumen contents of cattle grazing on plutonium-contaminated desert vegetation at the Nevada Test Site, Area 13, were collected quarterly and incubated in simulated bovine gastrointestinal fluids to study the alimentary availability of field-deposited plutonium-238, plutonium-239, and americium-241. Results to date indicate that the highest concentrations of plutonium and americium in the rumen contents occurred during the late summer or fall.

51254 (NVO—178, pp 489-503) **Plutonium-237: an important research tool for studies of environmental plutonium kinetics.** Trabalka, J.R.; Eyman, L.D. (Oak Ridge National Lab., TN). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

The production and use of the photon-emitting isotope plutonium-237 in investigations of the uptake, retention, and distribution of monomeric plutonium (IV) both in an aquatic vertebrate, the channel catfish Ictalurus punctatus, and in a littoral aquatic microecosystem, are presented. The rationale for use of plutonium-237 in environmental studies is discussed. Chelation can either enhance or reduce the uptake of ingested plutonium relative to plutonium hydroxide (monomer) in channel catfish. The highest observed retention (whole body) at 63 days was 3.8% of ingested dose for plutonium-237 citrate, while retention of the fulvate was 0.6%. Reduced uptake of the fulvate complex is due either to its high molecular weight (>10,000) or to its stability in metabolic systems. Increased uptake of plutonium-237 citrate is attributable to instability of the complex in metabolic systems. Tissue distribution studies revealed that relatively little (less than or equal to 10%) of intracardially injected plutonium citrate was excreted. Blood clearance rates were similar to those found in small mammals, with the plutonium being primarily associated with the plasma protein transferrin. The fractional body burdens in bone, liver, and kidney 17 days after injection were 31%, 24%, and 9% of the injection dose, respectively. High kidney burdens relativity to mammals are expected, since the kidney functions as the major site of homopoiesis in teleosts. Absence of significant excretion indicates that a short half-life component of elimination following gut clearance in gavage studies is due to plutonium labeling of the gut.

51255 **Behavior of neptunium-237 in subcellular fractions of rat kidney.** Kreslov, V.V.; Maksutova, A.Ya.; Mushkacheva, G.S. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 1, 98-104(1978).

Translated from Radiobiologiya: 18: No. 1, 84-88(1978).

A study was made of subcellular distribution of pentavalent (V) and hexavalent (VI) neptunium in the kidneys of male and female rats after intravenous injection of the radionuclide in a dosage of 1 μCi/rat. The subcellular fractions were obtained by the method of differential centrifugation. The studies revealed that the radioactive element is nonuniformly distributed in the cell. Most of the neptunium, about 50%, is concentrated in the mitochondrial fractions already 1 day after injection of the isotope. Data are submitted indicative of certain differences in the behavior of neptunium in

subcellular fractions of the rat kidney, depending on sex of the animal, as well as valency and dosage of administered isotope.

PLANTS

REFER ALSO TO CITATION(S) 51034, 51077, 51080, 51331

51256 (NVO—178, pp 321-330) **Root uptake of transuranic elements.** Schulz, R.K. (Univ. of California, Berkeley). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

The uptake of elements by plant roots is one of the important pathways of entry of many elements into the food chain of man. Data are cited showing plutonium concentration ratios, plant/soil, ranging from 10^{-10} to 10^{-3}. Concentration ratios for americium range from 10^{-7} to 10^{+1}. Limited experiments with curium and neptunium indicate that root uptake of curium is similar to that of americium and that plant uptake of neptunium is substantially larger than that of curium and americium. The extreme ranges of concentration ratios cited for plutonium and americium are due to a number of causes. Experimental conditions such as very intensive cropping will lead to abnormally high concentration ratios. In some experiments, addition of chelating agents markedly increased plant root uptake of transuranic elements. Particle size and composition of the source material influenced uptake of the transuranics by plants. Translocation within the plant, and soil factors such as pH and organic matter content, all affect concentration ratios.

51257 (NVO—178, pp 331-349) **Retention, absorption, and translocation of foliar contaminants.** Cataldo, D.A.; Vaughan, B.E. (Battelle Pacific Northwest Labs., Richland, WA). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976). In Transuranics in natural environments.

The interaction of airborne pollutants with foliage of terrestrial plants has been investigated from many aspects including interception, retention and absorption. Although interception parameters for both gaseous and particulate pollutants have been effectively modeled, the behavior and fate of pollutants following foliar interception are unresolved. This is especially true for particulates. Particles having 10 to 200 μm diameters exhibit retention half-times of 10 to 24 days. However, direct and indirect data suggest that submicronic particles are more effectively retained on plant foliage than are larger particles analogous to close in fallout. Studies are presented to describe the retention behavior of submicronic size particles deposited onto foliage of bushbean and sugar beet plants. Retention efficiency was evaluated using a simulated rainfall. These studies showed submicronic particles to be increasingly less available for leaching with increasing residence time on the leaf, with >90% of the foliar plutonium deposits being firmly held to the leaf surface. Retention mechanisms are discussed based on leaf morphology and leaching regimes employed. The absorption of foliar plutonium and its subsequent translocation to seed and root tissues was dependent on a number of parameters including chemical form and the presence or absence of a solution vector.

51258 Investigation of routes of contamination of plants with polonium 210 and lead 210. Popova, O.N.; Taskaev, A.I. (Inst. of Biology, Syktyvkar, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 6, 147-151(1977).

Translated from Radiobiologiya; 17: No. 6, 924-927(1977).

Studies were conducted in a system simulating a region of high natural radioactivity. Superficial parts of barley plants were contaminated with ^{210}Po and ^{210}Pb. In other experiments tops of plants were cut off and the roots were exposed to the radioisotopes. In the first group of plants the concentration of ^{210}Po and ^{210}Pb in the lower leaves was 14 to 17 times higher in the experimental zone than in the control zone. Polonium-210 and ^{210}Pb accumulated in the roots of all plants and the increase was greater in roots of plants with tops removed. The data confirmed the possibility of appreciable local aerial contamination of plants with daughter products of radon fission and that such contamination is present in territories with a high level of natural radioactivity. (HLW)

MICROORGANISMS

REFER ALSO TO CITATION(S) 51331

VERTEBRATES

REFER ALSO TO CITATION(S) 51082

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 49527, 50975, 50987, 51057, 51102, 51103

51259 (ANL—76-88(Pt.3), pp 23-25) **Effects of cadmium on the growth and assimilation of inorganic carbon by Asterionella formosa and Fragilaria crotonensis.** Conway, H.L.; Williams, S.C. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

The objective of this study was to investigate the impact of cadmium exposure on the growth and utilization of inorganic carbon by Asterionella formosa and Fragilaria crotonensis. No effects were observed for F. crotonensis at either of the concentrations tested. A. formosa showed inhibition of ^{14}C incorporation and a decline in growth rate at 5 and 10 μg Cd/l, the most pronounced effects being observed at the higher cadmium concentration.

51260 (ORNL/EIS—106) **Reviews of the environmental effects of pollutants: IV. Cadmium.** Hammons, A.S.; Huff, J.E.; Braunstein, H.M.; Drury, J.S.; Shriner, C.R.; Lewis, E.B.; Whitfield, B.L.; Towill, L.E. (Oak Ridge National Lab., Tenn. (USA); Cincinnati Univ., Ohio (USA); Environmental Protection Agency, Cincinnati, Ohio (USA). Health Effects Research Lab.). Jun 1978. Contract W-7405-ENG-26. 275p. (EPA—600/1-78-026). Dep. NTIS, PC A12/MF A01.

This report is a comprehensive, multidisciplinary review of the health and environmental effects of cadmium and specific cadmium derivatives. More than 500 references are cited. The cadmium body burden in animals and humans results mainly from the diet. In the United States, the normal intake of cadmium for adult humans is estimated at about 50 μg per day. Tobacco smoke is a significant additional source of cadmium exposure. The kidneys and liver together contain about 50% of the total cadmium body burden. Acute cadmium poisoning is primarily an occupational problem, generally from inhalation of cadmium fumes or dusts. In the general population, incidents of acute poisoning by inhaled or ingested cadmium or its compounds are relatively rare. The kidney is the primary target organ for toxicity from prolonged low-level exposure to cadmium. No causal relationship has been established between cadmium exposure and human cancer, although a possible link between cadmium and prostate cancer has been indicated. Cadmium has been shown to be teratogenic in rats, hamsters, and mice, but no such effects have been proven in humans. Cadmium has been reported to increase the frequency of chromosomal aberrations in cultured Chinese hamster ovary cells and in human peripheral leukocytes. The major concern about environmental cadmium is the potential effects on the general population. There is no substantial evidence of hazard from current levels of cadmium in air, water, or food. However, because cadmium is a cumulative poison and because present intake provides a relatively small safety margin, there are adequate reasons for concern over possible future increases in background levels.

CELLS

REFER ALSO TO CITATION(S) 51163, 51287

51261 Human bronchus-mediated mutagenesis of mammalian cells by carcinogenic polynculear aromatic hydrocarbons. Hsu, I.C. (National Cancer Inst., Bethesda, MD); Stoner, G.D.; Autrup, H.; Trump, B.F.; Selkirk, J.K.; Harris, C.C. *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 4, 2003-2007(Apr 1978).

Cultured human bronchial explants activated benzo[a]pyrene (BzaP) into electrophilic metabolites that bind to DNA in bronchial epithelial cells. Promutagenic and mutagenic metabolites of BzaP were also released into the culture medium. An increase in mutation frequency for ouabain resistance was found in Chinese hamster V-79 cells when they were cocultivated with bronchial explants in the presence ofBzaP. The proximate carcinogenic form of BzaP, the 7,8-diol [(+-)-r7,t8-dihydroxy-7,8-dihydrobenzo[a]pyrene], was 5-fold more potent as a promutagen than the parent compound. Neither BzaP nor the 7,8-diol increased the mutation frequency in V-79 cells when they were cultured without bronchial explants. The mutation frequency was directly related to the binding levels of BzaP to bronchial DNA and the concentration of either BzaP or the 7,8-diol in the medium.

MICROORGANISMS

REFER ALSO TO CITATION(S) 51061, 51169, 51259, 51264

PLANTS

REFER ALSO TO CITATION(S) 51013, 51061, 51126, 51330

51262 (ANL—76-88(Pt.3), pp 1-2) **Preliminary study of varietal susceptibility to sulfur dioxide.** Miller, J.E.; Xerikos, P.B. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

The injury response of plants to air pollutants, such as sulfur dioxide, is known to vary in severity and type for different varieties or cultivars of a species. Differences in the susceptibility of soybean varieties to sulfur dioxide have previously been noted, but sufficient information is not available concerning the sulfur dioxide resistance of varieties commonly grown in the Midwest. Results are reported from preliminary experiments concerning acute sulfur dioxide effects on 12 soybean varieties. The injury symptoms ranged from cream colored necrotic lesions (generally on younger leaves) to a reddish brown necrotic stipling (on older leaves). Differences in the severity of symptom development for the varieties was evident on both the younger and older leaves. No injury was apparent with three of the varieties (Amsoy 71, Corsoy, and Hark).

51263 (ANL—76-88(Pt.3), pp 6-8) **Influence of nitrogen fertility levels on SO_2 fumigation response in soybeans.** Muller, R.N.; Miller, J.E. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

While species and varieties of crop plants exhibit inherent differences in susceptibility to air pollutant damage, the extent of damage may be significantly influenced by the environmental conditions of growth. In crop plants, where fertility levels of different sites or different farming practices vary considerably, nutrition may strongly influence the degree of damage. This study was designed to assess the interaction of nitrogen fertility levels and SO_2 exposure upon photosynthesis of soybean (Glycine max c.v. Amsoy 71). Reduction of photosynthetic biomass in the low nitrogen treatment suggests that the ultimate yield (both total biomass and seed production) of the mature plants would be considerably reduced by SO_2 exposure.

51264 (ANL—76-88(Pt.3), pp 20-22) **Sorption of cadmium by Asterionella formosa and Fragilaria crotonensis.** Conway, H.L.; Williams, S.C. 1976.

In Radiological and Environmental Research Division annual report: Ecology, January—December 1976.

Trace elements such as cadmium, which is known to be toxic at elevated concentrations, are incorporated by phytoplankton and then transferred through zooplankton to higher trophic levels of aquatic organisms and eventually to man. A subtle response by a lower trophic level organism to a particular trace pollutant may eventually reveal itself as a significant change at the higher level of fish or man. Accumulation of toxic pollutants in the biota can lead to decreased rates of growth and reproduction and changes in the community structure. Results are reported from a study to determine the sorption characteristics of cadmium by two of the major diatom species found in Lake Michigan. Short-term (<48 hr) sorption experiments were carried out using unialgal populations of Asterionella formosa and Fragilaria crotonensis that had been previously grown in steady-state chemostats. Cellular cadmium content appeared to be a hyperbolic function of time for both species. Populations of A. formosa accumulated approximately three times as much cadmium as F. crotonensis populations after 24 hr of cadmium exposure.

51265 **Excess trace metal effects on cotton. I. Copper, zinc, cobalt and manganese in solution culture.** Rehab, F.I. (Univ. of Helwan, Alexandria, Egypt); Wallace, A. *Commun. Soil Sci. Plant Anal.;* **9**: No. 6, 507-518(1978).

Two cultivars of cotton (Gossypium spp) were grown in solution culture in a glasshouse to determine phytotoxicity effects of excesses of Cu, Zn, Co, and Mn. Leaf yields of Acala SJ-2 were depressed 76% by 10^{-4} M $CuSO_4$, 86% by 5 x 10^{-4} M $ZnSO_4$, 82% by 10^{-4} M $CoSO_4$, and 20% by 10^{-3} M $MnSO_4$. Leaf concentrations associated with these depressions were ($\mu g/g$) 110 Cu, 198 Zn, 180 Co, and 5470 Mn respectively. Plants were tolerant of, in $\mu g/g$, about 15 Cu, 106 Zn, 69 Co, and 1830 Mn. Leaf yields of Giza 70 were depressed 91% by 10^{-4} M $CuSO_4$, 88% by 5 x 10^{-4} M $ZnSO_4$, 87% by 10^{-4} M $CoSO_4$, and 68% by 10^{-3} M $MnSO_4$. This cv was less tolerant of Mn than was Acala SJ-2. Leaf metal concentrations at these application rates were ($\mu g/g$) 65 Cu, 243 Zn, 255 Co, and 6550 Mn respectively. In general roots were higher in these four metals than stems and leaves. There was no strong gradient from stems to leaves. Many nutrient interactions were observed as result of excesses of the four trace metals.

51266 **Excess trace metal effects on cotton: II. Copper, zinc, cobalt and manganese in yolo loam soil.** Rehab, F.I. (Univ. of Helwan, Alexandria, Egypt); Wallace, A. *Commun. Soil Sci. Plant Anal.;* **9**: No. 6, 519-527(1978).

Two cultivars of cotton (Gossypium spp.) were grown in Yolo loam soil (soil pH about 6) in pots in a glasshouse to determine phytotoxic effects of excesses of Cu, Zn, Co, and Mn. Leaf yields of cv. Acala SJ-2 were depressed 35% by 400 μg Cu/g soil, 54% by 400 μg Zn/g soil, 98% by 400 μg Co/g soil, and 84% by 2000 μg Mn/g soil. Leaf metal concentrations at these application levels in $\mu g/g$ leaf were 12.0 Cu, 520 Zn, 243 Co, and 14780 Mn, respectively. Plants were tolerant in $\mu g/g$ dry leaves of 10 Cu, 157 Zn, and 444 Mn. The concentration for Co could not be ascertained. Leaf yields of cv. Giza 70 were depressed 53% by 400 μg Cu/g soil, 25% by 400 μg Zn/g soil, 92% by 400 μg Co/g soil, and 90% by 2000 μg Mn/g soil. This cv. was more tolerant of Zn than Acala SJ-2. Leaf metal concentrations at these application levels in $\mu g/g$ leaf were 11.8 Cu, 312 Zn, 224 Co, and 18300 Mn, respectively. Gradients of these four elements existed from leaves to stems. Many interactions with other elements were observed.

51267 **Forest leaf litter decomposition in the vicinity of a zinc smelter.** Strojan, C.L. (Rutgers-The State Univ., New Brunswick, NJ). *Oecologia (Berlin);* **32**: 203-212(1978).

Concentrations of about 26,000 ppM Zn, 10,000 ppM Fe, 2,300 ppM Pb, 900 ppM Cd, 340 ppM Cu, and 0.40% S were measured in the O_2 litter horizon about 1 km from a zinc smelter at Palmerton, Pennsylvania. Samples taken about 6 km east of the smelter had concentrations of about 15,000 ppM Zn, 6,500 ppM Fe, 970 ppM Pb, 250 ppM Cd, 170 ppM Cu, and 0.26% S. Samples from a control area about 40 km east of the smelter had concentrations of 2,800 ppM Fe, 650 ppM Zn, 260 ppM Pb, 50 ppM Cu, 9 ppM Cd, and 0.13% S. Litter bags were used to estimate first-year weight loss in sassafras leaves and a mixture of chestnut oak/red oak leaves in the three sites. At the end of one year, average weight loss for sassafras was 39.3% in the control site, 21.8% at 6 km, and 17.5% at the 1 km site. For the chestnut oak/red oak mixture, average weight loss was 36.8% (40 km), 25.7% (6 km), and 19.1% (1 km). Numbers and diversity of soil microarthropods inhabiting the litter bags showed a corresponding decline at sites near the smelter. Concentrations of Ca, Cd, Cr, Cu, Fe, Mg, Mn, N, Na, Ni, P, Pb, S and Zn in the decomposing litter were also measured. The average amount of organic matter on the forest floor was estimated to be 3.8 kg/m^2 in the control site, about 3.8 kg/m^2 at 6 km, and about 8.1 kg/m^2 1 km from the smelter. Average thickness of the litter horizons in these three sites was 6.0 cm (40 km), 7.0 cm (6 km), and 12.4 cm (1 km), suggesting a long-term depression of decomposition and mineral cycling near the smelter.

INVERTEBRATES

REFER ALSO TO CITATION(S) 50998, 51048, 51049

51268 **Interaction of lead and calcium uptake by the woodlouse, Porcellio scaber (Isopoda, porcellionidae).** Beeby, A. (Univ. of Leicester, Eng.). *Oecologia (Berlin);* **32**: 255-262(1978).

Lead and calcium nitrate in a potato base were fed to Porcellio scaber; three levels of each cation were used in a 3^2 factorial design experiment. The amounts accumulated were determined by atomic absorption spectrophotometric analysis of nitric acid digests of whole animals. Both cations increased markedly in the woodlice with increasng dosage and a clear correlation was found between the rates of uptake of the two.

51269 **Fate of labeled n-alkanes in the blue crab and stripped mullet.** Geiszler, P.C.; Grantham, B.J.; Blomquist, G.J. (Univ. of Southern Mississippi, Hattiesburg). *Bull. Environ. Contam. Toxicol.;* **17**: No. 4, 463-467(Apr 1977).

The uptake, discharge, and metabolism of long chain n-alkanes was studied in the blue crab, Callinectes sapidus, and the stripped mullet, Mugil cephalus. Labelled n-alkanes were introduced into the digestive tract by dissolving the labeled n-alkane in mazola oil and placing it in the esophagus of fish or by placing the labeled n-alkane on food, and feeding it to crabs which had been deprived of food for 2 days. In all cases, organisms that did not appear to take in the labeled substrate were discarded. Results demonstrated that the blue crab was readily able to take up and discharge labeled n-alkanes, but it was not able to metabolize them. In contrast, it appeared that n-alkanes taken up via the digestive tract in mullet were readily metabolized, probably via micro-organisms in the gut. More limited metabolism was observed in mullet when n-alkanes were taken up via the gills.

51270 **Survival of the causative organism of strongyloidiasis in waters of coal mines.** Dyubina, T.A. pp 169-171 of Probl. parazitol. mater. nauchn. konf. parazitol. Markevich, A.P. (ed.). Kiev; Akademiya Nauk Ukrainskoi SSR (1975).

Laboratory cultivation of the organisms in coal mine waters of various compositions is reported. The term of survival (less than 23 days) of the larvae was dependent on pH, total mineral content and Fe content in mildly alkaline (pH 7-8) and moderately mineralized waters containing less than 2 mgFe/1.

VERTEBRATES

REFER ALSO TO CITATION(S) 50998, 51065, 51066, 51126, 51146, 51164, 51246, 51269

51271 (COO—2737-7) **Temporal aspects of tumorigenic response to individual and mixed carcinogens. Comprehensive progress report, June 1, 1975—May 31, 1978.** Albert, R.E.; Burns, F.J.; Altshuler, B. (New York Univ., N.Y. (USA). Inst. of Environmental Medicine). Feb 1978. Contract EY-76-S-02-2737. 122p. Dep. NTIS, PC A06/MF A01.

The research proposed here is designed to obtain a better understanding of the temporal kinetics of tumor induction when one or more carcinogens are present simultaneously or sequentially for prolonged periods of time. Studies done to date under this contract have shown that carcinogenesis in mouse skin by polycyclic aromatic hydrocarbon carcinogens is consistent with the induction of dependent and autonomous cell transformations by the carcinogen followed by the conversion of autonomous tumor cells into malignancies at a rate which is determined by the level of carcinogen exposure. Dependent cell transformations remain latent in the skin unless expressed by a promoting agent. Dependent neoplasia appears to follow one-hit kinetics while malignancy is a multihit endpoint. Dose-related and time-related aspects of tumor induction are separable in the initiation-promotion system of mouse skin which along with rat skin and hamster lung is being used as a model for testing hypotheses. Results to date provide the basis for a new interpretation of the linear non-threshold extrapolation model. The broad aim of the study is to provide a basis or rationale for estimating risks associated with prolonged exposures to carcinogens found in the environment and to predict how different tissues and species respond to the same carcinogens.

51272 (LA—7367-MS) **Preliminary toxicological study of Silastic 386 catalyst.** Smith, D.M.; Drake, G.A.; Holland, L.M.; Jackson, D.E.; London, J.E.; Prine, J.R.; Thomas, R.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1978. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

The calculated acute oral LD_{50}[30] values for Silastic 386 catalyst were 1225 mg/kg in mice and 4350 mg/kg in rats. According to classical guidelines, the compound would be slightly to moderately toxic in both species. Skin application studies in the rabbit demonstrated the compound to be mildly irritating. The eye irritation study disclosed the compound to be a severe irritant causing conjunctivitis, photophobia, corneal edema, corneal ulceration, anterior uveitis, and keratitis. The sensitization study in the guinea pig did not show Silastic 386 catalyst to be deleterious in this regard.

51273 (LA—7368-MS) **Preliminary toxicological study of Sylgard 184 curing agent.** Smith, D.M.; London, J.E.; Drake, G.A.; Thomas, R.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1978. Contract W-7405-ENG-36. 4p. Dep. NTIS, PC A02/MF A01.

The acute oral LD_{50}[30] values for mice and rats receiving Sylgard 184 curing agent were greater than 5 g/kg. According to classical guidelines, the compound would be considered slightly toxic or practically nontoxic in both species. Skin application studies in the rabbit demonstrated the compound to be mildly irritating. Eye irritation studies, also in the rabbit, showed that Sylgard 184 curing agent was a mild but transitory irritant. The sensitization study in guinea pigs did not show the resin to be deleterious.

51274 (LA—7369-MS) **Preliminary toxicological study of Sylgard 184 encapsulating resin.** Smith, D.M.; Drake, G.A.; London, J.E.; Thomas, R.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1978. Contract W-7405-ENG-36. 4p. Dep. NTIS, PC A02/MF A01.

The acute oral LD_{50}[30] values for Sylgard 184 encapsulating resin in mice and rats were greater than 5 g/kg. According to classical guidelines, the compound would be considered slightly toxic or practically nontoxic in both species. Skin application studies in the rabbit demonstrated this material to be mildly irritating. Eye irritation studies, also in the rabbit, showed that Sylgard 184 encapsulating resin was a mild but transitory irritant. The sensitization study in guinea pigs did not show the resin to be deleterious in this regard.

51275 (ORAU/IEA—78-2(R), pp 185-186) **Split-dose recovery after chemical attack.** Burns, F. (New York Univ., NY). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: relation of split-dose recovery to specific biological repair process; evidence for lack of split-dose recovery for chemicals in induction of skin tumors; dose-rate effect for chemicals; mouse skin initiation-promotion experiments; and effect of promoters on cell proliferation in mouse skin. (HLW)

51276 **Regional alterations of brain biogenic amines in young rats following chronic lead exposure.** Dubas, T.C.; Stevenson, A.; Singhal, R.L.; Hrdina, P.D. (Univ. of Ottawa). *Toxicology;* **9**: No. 2, 185-190(Feb 1978).

An examination was made of neurochemical changes that occur in discrete brain regions of rats that have been chronically exposed to low levels of lead from birth, in order to provide further information on the involvement of brain biogenic amines in lead-induced neurotoxicity. Results indicate a relationship between exposure to lead and alterations in the brain levels of various putative neurotransmitters. However, changes in the functional activity of the neurotransmitter may not be adequately reflected in the change of its steady-state levels or may occur even in the absence of any changes in the actual concentrations. Lead may influence central neurotransmitter function by affecting one or several of the processes involved in the synthesis, release and/or disposition of biogenic amines.

51277 **Neurotoxic response of infant monkeys to methylmercury.** Willes, R.F.; Truelove, J.F.; Nera, E.A. (Bureau of Chemical Safety, Ottawa). *Toxicology;* **9**: No. 2, 125-135(Feb 1978).

Four infant monkeys were dosed orally with 500 μg Hg/kg body wt./day (as methylmercury (MeHg) chloride dissolved sodium carbonate) beginning at 1 day of age. Neurological and behavioral signs of MeHg toxicity and blood Hg levels were monitored weekly. At first sign of MeHg intoxication, dosing with MeHg was terminated and the infants were monitored to assess reversal of the signs of MeHg toxicity. The first signs of MeHg toxicity, exhibited as a loss in dexterity and locomotor ability, were observed after 28 to 29 days of treatment; the blood Hg levels were 8.0 to 9.4 μg Hg/g blood. Dosing was terminated at 28 to 29 days of treatment but the signs of MeHg toxicity continued to develop. The infants became ataxic, blind, comatose and were necropsied at 35 to 43 days after initiating treatment with MgHg. The mercury concentrations in tissues analyzed after necropsy were highest in liver followed by occipital cortex and renal cortex. The mean blood/brain ratio was 0.21 +- 0.4. Histopathologic lesions were marked in the cerebrum with less severe lesions in the cerebellar nuclei. The Purkinje and granular cells of the cerebellar vermis appeared histologically normal. Lesions were not observed in the peripheral nervous system. The signs of MeHg intoxication, the tissue distribution of MeHg and histopathologic lesions observed in the infant monkeys were similar to those reported for adult monkeys.

51278 **Heme synthesis in the lead-intoxicated mouse embryo.** Gerber, G.B.; Maes, J. (C.E.N., Mol, Belgium). *Toxicology;* **9**: No. 2, 173-179(Feb 1978).

Incorporation of ^{55}Fe and of [^{14}C] glycine was studied in control embryos and mothers and in those which had received lead in the diet from day 7 of pregnancy. Incorporation of Fe into heme of embryonic liver which increases markedly for controls on day 17 of pregnancy was depressed greatly and showed no such increase in lead-intoxicated embryos. These embryos were retarded in growth but had normal heme concentrations in body and liver. Incorporation of glycine into embryonic heme and proteins was not affected. Data on incorporation in the mothers are also presented. It is thought that the impaired synthesis of heme in lead-intoxicated embryos limits their body growth during the late phase of pregnancy.

51279 **Inhalation toxicity studies on cigarette smoke. V. Deposition of smoke particles in the respiratory system of rats under various exposure conditions.** Binns, R.; Lugton, W.G.D.; Wilton, L.V.; Dyas, B.J. (British-American Tobacco Co. Ltd., Southampton, Eng.). *Toxicology;* **9**: No. 2, 87-102(Feb 1978).

The paper describes a dosimetry experiment on rats which was designed to make a contribution towards the optimization of exposure conditions for inhalation toxicology studies with smoke aerosols. The main conclusions drawn from the work are: (1) Under continuous exposure conditions the deposition of total particulate matter (TPM) in the respiratory system and carboxyhaemoglobin (COHb) levels in blood were linearly dependent on the concentration of smoke in the exposure chamber. (2) Intermittent exposure gave relatively lower TPM deposition compared to continuous exposure, even after allowing for differences in actual exposure times. (3) For arithmetically equivalent exposure levels, short exposure to high concentration gave greater TPM deposition than long exposures to low smoke concentrations. (4) There was a good correlation between lower respiratory system (LRS) and lung deposition of TPM and blood COHb level for both continuous and intermittent exposure conditions. These findings are discussed in relation to the conduct of inhalation studies with tobacco smoke.

51280 **Leukocyte recruitment to airways by aldehyde-carbon combinations that mimic cigarette smoke.** Kilburn, K.H.; McKenzie,

W.N. (Univ. of Missouri, Columbia). *Lab. Invest.;* **38**: No. 2, 134-142(Feb 1978).

Exposure of Syrian golden hamsters to formaldehyde (3 to 250 ppM) evaporated onto carbon (21 to 805 mg per cu. m) recruited polymorphonuclear (PMN) leukocytes to the epithelium of tracheas and intrapulmonary airways which peaked at 24 to 48 hours. Acrolein (< 6 ppM) on carbon 593 mg per cu. m) caused PMN recruitment which was maximal at 12 hours. The vapor phase of cigarette smoke produced PMN leukocyte recruitment of the same magnitude and with the same time course. In contrast, exposure to formaldehyde at doses of 2 to 250 ppM and acrolein at 6 ppM was cytotoxic to airway cells and caused prompt and delayed exfoliation but no recruitment of PMN leukocytes. There was no difference in cytotoxicity when carbon was present. Leukocyte recruitment occurred only when carbon was present, either given simultaneously with aldehydes or with adsorbed aldehydes. Thus, aldehyde vapor simulates the cytotoxic effects of particle-free cigarette smoke vapor. Of greater significance is the finding that an aldehyde, formaldehyde or acrolein, inhaled adsorbed on carbon or simultaneously with carbon to hamster airways is chemotactic for PMN leukocytes just as is the vapor phase of cigarette smoke when given simultaneously with carbon particles.

51281 Morphometric and morphologic evaluation of pulmonary lesions in beagle dogs chronically exposed to high ambient levels of air pollutants. Hyde, D.; Orthoefer, J.; Dungworth, D.; Tyle, W.; Carter, R.; Lum, H. (Univ. of California, Davis). *Lab. Invest.;* **38**: No. 4, 455-469(Feb 1978).

Beagle dogs (104) comprising one control and seven treatment groups were exposed 16 hours daily for 68 months to filtered air, raw or photochemically reacted auto exhaust, oxides of sulfur or nitrogen, or their combinations. After a further 32 to 36 months in clean air, morphologic examination of lungs by light microscopy, scanning electron microscopy, and transmission electron microscopy revealed two important exposure-related lesions. They were enlargement of air spaces in proximal acinar regions, with and without increases in the number and size of interalveolar pores, and hyperplasia of nonciliated bronchiolar cells. Proximal enlargement of air spaces was most severe, both subjectively and morphometrically, in those dogs exposed to oxides of nitrogen, oxides of sulfur, or oxides of sulfur with photochemically reacted auto exhaust. In contrast, hyperplasia of nonciliated bronchiolar cells was most severe in dogs exposed to raw auto exhaust alone or with oxides of sulfur. The air space enlargement and hyperplasia of bronchiolar epithelium correlated with functional impairment reported as occurring in these dogs. Foci of ciliary loss with and without squamous metaplasia were occasionally observed in the trachea and bronchi. The observations indicate that enlargement of proximal acinar air spaces with some loss of interalveolar septa can develop in the absence of alveolar fenestrations. The persistent nature of bronchiolar cell proliferations in such circumstances was also demonstrated. Two major toxicologic implications are (1) the production of permanent lung damage by much lower concentrations of pollutants than previously reported and (2) the apparent lack of additive or synergistic effects between oxidant gases and sulfur oxides.

51282 Changes in activity of malate dehydrogenase and glucosephosphate isomerase in serum of rats exposed chronically to inorganic mercury and its aryl and alkyl compounds. Chmielnicka, J.; Balcerska, I.; Pietruszczak, A.; Brzeznicka, E. (Inst. of Environmental Research and Bioanalysis, Lodz, Poland). *Bull. Environ. Contam. Toxicol.;* **17**: No. 4, 447-455(Apr 1977).

In course of prolonged exposure (14 weeks) to various mercury compounds (MetHg - a fluid seed-dressing preparation 0,8, Phenyl and Ethyl chlorides and $HgCl_2$ in doses corresponding to 5% of DL_{50}, 3 times weekly), enhanced levels of activity of malate dehydrogenase (MDH) and glucosephosphate isomerase (PHI) in blood serum were observed. After 7 weeks of exposure about fourfold increase of MDH and 2-3-fold enhancement of PHI activities were found relative to controls. After 14 weeks of exposure in livers of rats, given MetHg and EtHg, organic mercury was found at concentrations of 28, 8 and 4 μg/g tissue, respectively. Inorganic mercury in liver was found in animals given all compounds and concentrations were in the range of 1,2 - 4,7 μg/g tissue.

51283 Effects of sulfur dioxide exposure on the post-natal development and hemotological studies in mice. Singh, J. (Stillman Coll., Tuscaloosa, AL). pp 147-151 of Environmental technology '76. Proceedings. Mt. Prospect, IL; Institute of Environmental Sciences (1976).

From Proceedings of the Institute of Environmental Sciences; Philadelphia, PA, USA (25 Apr 1976).

See CONF-760411—.

Continuous exposure of mice to SO_2 for six weeks reduced the average weight of mice, and also the weight of liver, kidneys, heart, brain, and spleen. Changes in erythrocyte and leukocyte numbers were also observed in blood samples.

51284 Metallothionein and the toxicity of cadmium. Webb, M. (MRC Toxicology Unit, Surrey, Eng.). pp 177-186 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

Some topics discussed are as follows: physiological function of metallothioneins in control of metabolism of trace metals; high cysteine content of metallothioneins; effect of cadmium dose on content of metallothionein in rat liver; zinc and copper in proteins of calf and lamb liver; protective effects of metallothionein against cadmium in mammals; antagonistic effects of cadmium on metabolism of zinc and copper; accumulation of cadmium in kidneys following chronic exposure; and effects of penicillamine on lethality and toxicity of cadmium. (HLW)

51285 Influence of polychlorinated biphenyl compounds on hepatic function in the rat. Ecobichon, D.J. (Dalhousie Univ., Halifax, Novo Scotia). pp 207-214 of Ecological toxicology research. Effects of heavy metal and organohalogen compounds. McIntyre, A.D.; Mills, C.F. (eds.). New York; Plenum Press (1975).

From Conference on eco-toxicology; Quebec, Canada (6 May 1974).

See CONF-7405125—.

Preliminary experiments showed that intraperitoneal doses of commercial PCB at a concentration of 50 mg/kg caused ultrastructural and enzymatic changes in rat liver. Pure chlorobiphenyls were injected into rats and the animals were killed 96 hr later. The livers were removed and samples were taken for light and electron microscope studies; the remaining tissue was prepared for enzymatic assays. Biphenyl and 4-monochlorobiphenyl did not cause induction of hepatic drug-metabolizing enzymes. Microsomal mono-oxygenases were induced by pure hexa- and octachlorobiphenyls and by di- and tetrachlorobiphenyls with chlorines substituted at the 3 and 4 positions of the rings. Nitroreductase and carboxylesterase activities were affected only by the highly chlorinated biphenyls whereas all agents caused induction of BSP conjugase. (HLW)

MAN

REFER ALSO TO CITATION(S) 50997, 51003, 51066, 51126, 51128

51286 (NVO—178, pp 1-5) **Early studies.** Stannard, J.N. (Univ. of Rochester, NY). Jun 1977.

From Symposium on dynamics of transuranics in terrestrial and aquatic environments; Gatlinburg, TN, USA (5 Oct 1976).

In Transuranics in natural environments.

Early studies on transuranics are reviewed with regard to the following: the first biomedical studies; continuing metabolic studies; studies of metabolism in man; and relative toxicity of plutonium. (HLW)

51287 (ORAU/IEA—78-2(R), pp 102-105) **Risk assessment and repair in chemical carcinogenesis.** Nettesheim, P. (Oak Ridge National Lab., TN). Feb 1978.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

In Summary and proceedings of a biology workshop on biological repair mechanisms and exposure standards.

The following topics are discussed: use of morphological transformation in cells exposed to chemical agents for risk assessment; difficulty of determining effective dose to mammalian systems exposed to toxic agents; risk of lung cancer in man following exposure to tobacco smoke; and pre-neoplastic changes in respiratory tract of rodents exposed to chemical carcinogens. (HLW)

51288 Metabolism of [^{3}H]benzo[a]pyrene by cultured human bronchus and cultured human pulmonary alveolar macrophages. Autrup, H.; Harris, C.C.; Stoner, G.D.; Selkirk, J.K.; Schafer, P.W.; Trump, B.F. (National Insts. of Health, Bethesda, MD). *Lab. Invest.;* **38**: No. 3, 217-224(Mar 1978).

The metabolism of [^{3}H]benzo[a]pyrene by cultured human bronchial epithelium and pulmonary alveolar macrophages was studied. Explants of bronchus were prepared and pulmonary alveolar macrophages were isolated from peripheral lung by trypsinization and by differential adhesion to plastic tissue culture dishes. After 7 days in culture the bronchus explant and the macrophages were exposed to [^{3}H]benzo[a]pyrene, and the binding to cellular macromolecules was studied. Aryl hydrocarbon hydroxylase activity was determined by the release of tritiated water into the culture medium from metabolized [^{3}H]benzo[a]pyrene. Variation in the binding level of benzo[a]pyrene to DNA and to protein in macrophages from different individuals showed 9- and 33-fold interindividual variation, respectively. In the macrophages, both binding of benzo[a]pyrene to macromolecules and aryl hydrocarbon hydroxylase activity were

dependent on the length of time in culture and length of exposure to benzo[a]pyrene. Pretreatment of the macrophages with benz[α]anthracene increased both binding level of benzo[a]pyrene and aryl hydrocarbon hydroxylase activity. When coincubated with benzo[a]pyrene, cycloheximide, 7,8-benzoflavone, or actinomycin D reduced both level of binding and activity of aryl hydrocarbon hydroxylase. When macrophage cultures were maintained at pO_2 greater than atmospheric air, an increase in binding level and enzyme activity was found. The major metabolites of benzo[a]pyrene formed by macrophages were 7,8-dihydroxy-7,8-dihydrobenzo[a]pyrene, 9,10-dihydroxy-9,10-dihydrobenzo[a]pyrene (16 to 39%) and two distinct peaks containing unidentified polar metabolites. A negative correction between binding of benzo[a]pyrene to protein and aryl hydrocarbon hydroxylase exists in pulmonary macrophages, but no correlation between data from bronchus and macrophages was found.

51289 Delta-aminolaevulinic acid metabolism in normal and lead-exposed humans. Meredith, P.A.; Moore, M.R.; Campbell, B.C.; Thompson, G.G.; Goldberg, A. (Stobhill General Hospital, Glasgow). *Toxicology;* **9**: No. 2, 1-9(Feb 1978).

The activity of the heme biosynthetic enzymes delta-aminolevulinic acid synthase (ALA.S) and delta-aminolevulinic acid dehydratase (ALA.D) were measured in the peripheral blood of a group of lead workers and control subjects. The heme precursor delta-aminolevulinic acid (ALA) was measured in blood and urine, while lead levels were measured in whole blood. The inter-relationships between all these parameters were examined and quantified. The results demonstrate that above a blood lead concentration of 2 μmole/l and below an erythrocyte ALA.D activity of 18 nmole. ALA utilized/min/ml red blood cells (R.B.C.), heme synthesis is depressed to such an extent that the activity of leucocyte ALA.S, the rate-limiting enzyme of heme biosynthesis, is increased by negative feedback.

51290 Arsenic exposure and mortality: a case-referent study from a Swedish copper smelter. Axelson, O.; Dahlgren, E.; Jansson, C.D.; Rehnlund, S.O. (Regional Hospital, Oerebro, Sweden). *Br. J. Ind. Med.;* **35**: No. 1, 8-15(Feb 1978).

An increased mortality from lung cancer, cardiovascular disease, hematolymphatic malignancy and cirrhosis of the liver has been reported among smelter workers and others exposed to arsenic. This study uses the case-referent (case-control) technique and is concerned with workers in a copper smelter in a complex work environment, characterized by the presence of trivalent arsenic in combination with sulphur dioxide and copper, and also with other agents. Lung cancer mortality was found to be increased about five-fold and cardiovascular disease about two-fold, showing a dose-response relationship to arsenic exposure. Mortality from malignant blood disease (leukemia and myeloma) and cirrhosis of the liver was also slightly increased. This mortality pattern among the smelter workers is consistent with earlier reports. An increased mortality from cardiovascular disease in this type of industry is of particular interest as it has been reported only once before.

51291 Determination of plasma lead levels in normal subjects and in lead-exposed workers. Cavalleri, A.; Minoia, C.; Pozzoli, L.; Baruffini, A. (Universita di Pavia, Italy). *Br. J. Ind. Med.;* **35**: No. 1, 21-26(Feb 1978).

Lead levels in whole blood and in plasma were measured in 64 non-exposed and in 29 exposed subjects with signs and symptoms of varying severity. Lead was determined by atomic absorption spectrophotometry after chelation with ammonium pyrrolidine dithiocarbamate and extraction with methyl isobutyl ketone. The method has a sensitivity of 0.4 μg/100 ml (0.02 μmol/1) for whole blood and of 0.2 μg/100 ml (0.01 μmol/1) for plasma and is reliably accurate and precise. Plasma lead increases progressively and significantly with the increase of whole blood lead, while its relative percentage in the plasma remains practically constant at all concentrations in whole blood. In exposed subjects a highly significant correlation was found between lead in plasma and lead in urine ($r = 0.549$) but the correlation coefficient was higher for whole blood lead versus urinary lead ($r = 0.938$). Aminolevulinic acid excretion in urine appeared to be significantly related to plasma lead concentration ($r = 0.563$) but to a greater extent to whole blood levels ($r = 0.801$). There was no significant correlation between lead in plasma and the logarithm of aminolevulinic acid dehydratase. The hypothesis is advanced that plasma lead, the more biologically active fraction of the metal, could be related to different individual sensitivities which would condition the development of toxic effects in various organs at different levels of lead.

51292 Mortality study of coke oven workers in two South Wales integrated steelworks. Davies, G.M. (British Steel Corp., Glamorgan, Eng.). *Br. J. Ind. Med.;* **34**: No. 4, 291-297(Nov 1977).

Six hundred and ten coke oven personnel were studied retrospectively over a period of 11 years (1954-65). During this time 82 died, 88 retired and 80 left, but all were traced. The Standardized Mortality Ratios (SMRs) have been calculated for four principal causes which have then been further analyzed into 30 subgroups. The work was limited because the population was small and the records not detailed enough to analyze the mortality rates according to environmental exposures. Differences between SMRs obtained at the two works were quite marked (73 and 98) and the overall SMR of 85 percent was better than expected. The observed number of deaths from respiratory disease, malignant neoplasms and all other causes excluding cardiovascular, was very near that expected, but the numbers of deaths from cardiovascular disease and in particular arteriosclerotic disease, showed a significant deficit.

51293 Cadmium metabolism in man. Welinder, H.; Skerfving, S.; Henriksen, O. (Univ. Hospital, Svaengsta, Sweden). *Br. J. Ind. Med.;* **34**: No. 3, 221-228(Aug 1977).

Twenty-one high frequency solderers, who had been exposed to cadmium (Cd) from a solder for periods ranging from 1 month to 18 years (median 8 months; present time-weighted average 30 nmol/m^3; particle size below 1μm) 1 had Cd levels ranging from $<$ 10 to 440 nmol/l in blood and from $<$ 0.5 to 27 μmol/mol creatinine in urine. Individual workers showed considerable variations in blood Cd levels with time, but less variation in urine levels. There was a statistically significant ($P < 0.001$) increase of Cd in urine with increasing exposure time. Four gas solderers, who had been intermittently exposed for 8 to 20 years (median 17 years), had Cd levels ranging from 45 to 150 nmol/l and urine levels of from 2 to 20 μmol/mol creatinine. There was no correlation between Cd levels in blood and urine during exposure. After exposure had ceased there was a considerable decay of blood Cd in most subjects. The half-time in 11 people ranged from 25 to 146 days (median 41 days). After the decay blood levels reached a steady state. Concentrations in urine did sot decrease, or did so only very slowly. There was a significant increase of levels in urine ($P < 0.001$) with increasing post-decay levels in blood. There was also a significant increase ($0.01 < P < 0.05$) of excretion of β_2-microglobulin in urine (range 1.1 to 18 mg/mol creatinine, median 4.7 mg/mol creatinine) measured 11 to 15 months after exposure had ceased, with increasing Cd levels in urine. This may indicate an effect on renal tubular function even at kidney Cd loads corresponding to Cd levels in urine of the order of as little as 10 μmol/mol creatinine.

51294 Cadmium concentration in samples of human kidney cortex from the 19th century. Elinder, C.G. (Karolinska Inst., Stockholm); Kjellstroem, T. *Ambio;* **6**: No. 5, 270-272(1977).

Cadmium content in samples of cortex from 30 adult human kidneys, preserved as museum specimens, was determined using atomic absorption spectrophotometry. The geometric mean of the cadmium concentrations was 15.1 μg/g dry weight, which is significantly less than what has been reported for fresh kidneys obtained from autopsied non-smokers in Sweden. Provided that the old samples have not lost significant amounts of cadmium during storage, these results indicate that the cadmium burden among humans in Sweden has increased during this century.

51295 WHO environmental health criteria for cadmium. *Ambio;* **6**: No. 5, 287-290(1977).

A report in preparation by the World Health Organization (WHO), Geneva, on the Environmental Health Criteria on Cadmium is summarized. This report will be published under the joint sponsorship of the United Nations Environment Program (UNEP) and WHO. Analytical problems, sources and pathways of exposure to cadmium, metabolism of cadmium, experimental studies on the effects of cadmium, clinical and epidemiological studies on the effects of cadmium, and dose response relationships and evaluation of risk are discussed. Further research in the areas of analytical methods, environmental distribution and transport, daily intake by man, and metabolism and toxic effects was recommended.

51296 WHO environmental health criteria for oxides of nitrogen. *Ambio;* **6**: No. 5, 290-292(1977).

A report in preparation by the World Health Organization (WHO), Geneva, on the Environmental Health Criteria for Oxides of Nitrogen is summarized. This report will be published under the joint sponsorship of the United Nations Environment Program (UNEP) and WHO. Chemistry and analytical methods, sources of oxides of nitrogen, environmental levels and exposures, effects on experimental animals, effects on man, and evaluation of health risks are discussed. Further research on the reaction of sensitive biological systems to nitrogen dioxide and oxidants, on the biological effects of nitric acid and nitrates, on the possibility of delayed effects, on epidemiological studies of occupational and community groups, and on asthmatic subjects and persons with cardiopulmonary disease was recommended.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

51297 (BNL—24337) **Influence of cadmium on salt-induced hypertension in Dahl hypertension-sensitive rats.** Ohanian, E.V.; Iwai, J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 12p. (CONF-780631—1). Dep. NTIS, PC A02/MF A01.

From 12. conference on trace substances; Columbia, MO, USA (5 Jun 1978).

This study investigated the influence of cadmium (Cd) on the pathogenesis of salt-induced hypertension in Dahl hypertension-sensitive (S) rats bred for susceptibility to the hypertensive effect of excess dietary salt (NaCl). Weanling female S rats were divided into two groups. The rats in the Cd group received 2 mg Cd/kg ip on week 3 (3 weeks of age) followed by 2nd and 3rd injections of 1 mg Cd/kg on weeks 6 and 23. The controls received the same volume of 0.9% aqueous NaCl ip. A high salt (4% NaCl) diet and tap water were available ad libitum. Cd enhanced the rate and the degree at which salt-induced hypertension developed (week 7), leading to an accelerated phase (week 24) associated with a mean systolic blood pressure of 245 mm Hg and drastically increased morbidity and mortality. Conversely, the hypertensive process in the controls averaging a blood pressure of 207 mm Hg was not heralded by other discernible toxic manifestations. Pathological lesions of periarteritis nodosa in the mesenteric arteries and nephrosclerosis occurred to the same extent in the Cd and control groups. This study demonstrated that Cd exacerbated the severity of salt-induced hypertension in S rats.

51298 **Biological effects of magnetic fields on man.** Ketchen, E.E.; Porter, W.E.; Bolton, N.E. (Oak Ridge National Lab., TN). *Am. Ind. Hyg. Assoc. J.;* **39**: No. 1, 1-11(Jan 1978).

The biological effects of the interaction of stationary magnetic fields (SMF) with man and other animals have been reviewed. The lowest detectable limit of interaction between higher animals and a SMF is 80 to 100 G. The recommended limit on an extended-period basis for whole-body or head exposure is 200 G. Higher limits of magnetic-field exposure for limited periods of time are contained within the report.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 49848, 51083

51299 (CONF-770478—P2, pp 1373-1374) **Hydrological applications of LANDSAT imagery of the 1973 Indus River flood, Pakistan.** Deutsch, M.; Ruggles, F.H. Jr. (Geological Survey, Reston, VA). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51300 (Y/OWI/TM—9/1) **Conceptual design criteria for facilities for geologic disposal of radioactive wastes in salt formations. Addendum No. 1.** (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 2 Mar 1977. Contract W-7405-ENG-26. 21p. (X-OE—17). Dep. NTIS, PC A02/MF A01.

Errata to the original report are tabulated. Generalized descriptions are given of a salt dome province and a representative salt dome within the province and of a bedded salt basin. (JSR)

51301 **Catagenetic transformation of disseminated organic matter (as middle carboniferous deposits in southwestern Donbass).** Neruchev, S.G. *Int. Geol. Rev.;* **20**: No. 4, 489-494(Apr 1978).

Translated from Geol. Nefti Gaza: No. 4, 39-45(1977).

Core material from sediments of the Bashkirian and Moscovian stages of the Middle Carboniferous in the southwestern Donbass was investigated. It was found that the processes of transformation of disseminated organic matter, and the generation and emigration of hydrocarbons in the Middle Carboniferous deposits of the Donbass, took place theoretically in the same way as in any other petroleum basin. The significantly humic nature of the disseminated organic matter even in the marine facies has determined their weak manifestation and, as a result, the insignificant ingress of disseminated hydrocarbons into the reservoirs. This could lead neither to the formation of pools nor even to the formation of significant oil shows. The processes of generation and emigration of hydrocarbons definitely accompany the catagenesis of disseminated organic matter during the course of sinking and lithogenesis of the sediments. Only the adequate enrichment of the sediments in disseminated organic matter and the large content of sapropelic components make possible the development of these processes on a scale ensuring commercial petroleum occurrences.

51302 **Formulations of rock mechanical calculations applied to cavities in salt domes and stratified salt.** Rokar, R.B.; Lux, K.H. (Technische Univ. Hannover (Germany, F.R.)); Lorenzen, H. (Kavernen Bau- und Betriebsgesellschaft m.b.H., Hannover (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **77/78**: 656-668(1977). (In German).

From 4. specialists' group meeting of the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V.; Koeln, Germany, F.R. (5 - 7 Oct 1977).

Some hundred salt cavities have been constructed in Europe and America in the past ten years. They are almost exclusively used as large-scale storage reservoirs for liquid and gaseous hydrocarbons. In salt domes their capacity can amount to 500 000 m^3 and sometimes even to 1 000 000 m^3. In stratified salt, however, cavities cannot reach such a size which is due to the fact that the thickness of the salt layers is inferior to those of salt domes. And a shallow, large-diameter cavity must be avoided so as to ensure that the cavity remains structurally sound. For an optimum utilisation of the respective salt formation with regard to economy and solution mining technique, special value must be attached to the geometrical shape of the cavity which again is dependent on the rock mechanical behaviour of the salt rock encountered and on the stability properties of the rock above and below the salt body. Based on the finite-element method some formulations of and prerequisites for cavity calculations are provided.

GEOPHYSICS

SEISMOLOGY AND TECTONICS

51303 **Earthquake hazards reduction: issues for an implementation plan.** Washington, DC; Office of Science and Technology Policy (1978). 253p.

After the passage of the "Earthquake Hazards Reduction Act of 1977", the President ordered the preparation of an implementation plan. This report, as a first step in that direction, attempts to identify the major policy issues, some of their ramifications, and some policy alternatives. The topics discussed are considerations in formulating such policies, issues involved in implementing such a program, and the roles of government and non-government organizations. In an appendix issues are listed which identify a problem area and which include background information, alternative solutions, and recommendations. (JSR)

VOLCANOLOGY

REFER ALSO TO CITATION(S) 49867

51304 **Experimental velocity and density determination of volcanic gases during eruption.** Steinberg, G.S.; Babenko, J.I. (Academy of Sciences, Kamchatsky, Russia). *J. Volcanol. Geotherm. Res.;* **3**: No. 1/2, 89-98(Mar 1978).

A method for determining velocity and density of volcanic gases from eruption movies is proposed. Gas velocities determined from observations at Alaid (1972) and Klutchevskoy (1974) volcanoes are 65 to 165 m/s and densities are 4.7 to 1.4 x 10^{-3} g/cm^3. Flow velocities and gas densities were estimated at Etna and Stromboli (1969 and 1971), using the distribution of volcanic bombs. Results for velocity and density are, respectively, 110 to 90 m/s and 3 to 5 x 10^{-3} g/cm^3 for Etna; 70 m/s and 0.7 to 3.1 x 10^{-4} g/cm^3 for Stromboli. Either stationary or non-stationary regimes may occur during gas flow. In the latter, the density and flow velocity can be determined and the depth at which the fluid gas ceases to be a dispersed bubble phase and becomes a continuous gaseous phase can also be specified. Data for Hole-in-the-Ground Maar are used to reconstruct flow parameters; we conclude that the fluid became a continuous gaseous phase at a depth of approximately 350 to 400 m depth.

51305 **Magnetic signatures of hydrothermal alteration and volcanogenic mineral deposits in oceanic crust.** Rona, P.A. (National Oceanic and Atmospheric Administration, Miami, FL). *J. Volcanol. Geotherm. Res.;* **3**: No. 1/2, 219-225(Mar 1978).

A growing body of field evidence supported by laboratory studies indicates that concentrated hydrothermal activity may affect the intensity of magnetization of basalt, producing a characteristic magnetic signature that may be associated with sites of hydrothermal mineral deposits. Field evidence favoring the existence of a magnetic signature indicative of hydrothermal deposits is summarized.

51306 Basin and range rifting in northern Nevada: clues from a mid-miocene rift and its subsequent offsets. Zoback, M.L.; Thompson, G.A. (Stanford Univ., CA). *Geology;* **6**: No. 2, 111-116(Feb 1978).

A linear rift composed of dike swarms and graben-filling volcanic rocks marks the inception of Basin and Range rifting in northern Nevada 17 to 14 m.y. ago. This mid-Miocene rift, with its associated aeromagnetic anomaly, indicates S68°W-N68°E (+-5°) extension. A small strike-slip (transform) fault at Sawtooth dike, one short element of the rift, confirms the mid-Miocene extension direction. The present extension, based on data throughout the Basin and Range province, is N65°W-S65°E (+-20°), which is consistent with younger fault offsets of the rift. In the Sawtooth dike region this 45° change in direction of extension took place between 15 and 6 m.y. B.P. The Nevada rift is thought to be a part of a linear rift zone roughly 700 km long, which includes feeder dikes of Columbia River basalts and the mid-Miocene location of the Yellowstone hot spot. Extension in this zone was probably perpendicular to a then-active trench along the western plate margin. The clockwise change in extension direction is consistent with a superposition of right-lateral shear along the plate margin when the San Andreas fault was activated.

51307 Observations of eruption clouds from Sakura-zima volcano, Kyushu, Japan, from Skylab 4. Friedman, J.D.; Heiken, G.; Randerson, D.; McKay, D.S. (Geological Survey, Denver). *J. Volcanol. Geotherm. Res.;* **1**: 305-329(1976).

Hasselblad and Nikon stereographic photographs taken from Skylab between 9 June 1973 and 1 February 1974 give synoptic plan views of several entire eruption clouds emanating from Sakura-zima volcano in Kagoshima Bay, Kyushu, Japan. Analytical plots of these stereographic pairs, studied in combination with meteorological data, indicate that the eruption clouds did not penetrate the tropopause and thus did not create a stratospheric dust veil of long residence time. A horizontal eddy diffusivity of the order of 10^6 cm^2 s^{-1} and a vertical eddy diffusivity of the order of 10^5 cm^2 s^{-1} were calculated from the observed plume dimensions and from available meteorological data. These observations are the first, direct evidence that explosive eruption at an estimated energy level of about 10^{18} ergs per paroxysm may be too small under atmospheric conditions similar to those prevailing over Sakura-zima for volcanic effluents to penetrate low-level tropospheric temperature inversions and, consequently, the tropopause over northern middle latitudes. Maximum elevation of the volcanic clouds was determined to be 3.4 km. The cumulative thermal energy release in the rise of volcanic plumes for 385 observed explosive eruptions was estimated to be 10^{20} to 10^{21} ergs (10^{13} to 10^{14} J), but the entire thermal energy release associated with pyroclastic activity may be of the order of 2.5 x 10^{22} ergs (2.5 x 10^{15} J). Estimation of the kinetic energy component of explosive eruptions via satellite observation and meteorological consideration of eruption clouds is thus useful in volcanology as an alternative technique to confirm the kinetic energy estimates made by ground-based geological and geophysical methods, and to aid in construction of physical models of potential and historical tephra-fallout sectors with implications for volcano-hazard prediction.

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 50970

51308 (CONF-770478—P1, pp 123) **Remote sensing in geographic applications.** Anderson, J.R. (Geological Survey, Reston, VA); Witmer, R.E.; Wray, J.R.; Shelton, R.L. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51309 (CONF-770478—P1, pp 125-135) **Remote sensing data processing: two years ago, today, and two years from today.** Holmes, Q.A. (Environmental Research Inst. of Michigan, Ann Arbor); Goodenough, D.; Erickson, J.D. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51310 (CONF-770478—P1, pp 179) **Geologic lineaments: remotely sensed bonanzas and extravaganzas.** Wise, D.U. (Univ. of Massachusetts, Amherst). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51311 (CONF-770478—P1, pp 181) **Comparative planetology: ideas and methodology; their application to terrestrial geologic processes.** Masursky, H. (Geological Survey, Flagstaff, AZ). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51312 (CONF-770478—P1, pp 243-246) **U.S. initiatives for remote sensing applications in the developing world.** Wilhelm, J.K. (U.S. agency for International Development, Washington, DC). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51313 (CONF-770478—P1, pp 277-278) **Remote sensing in rangeland management: an overview of applications and benefits.** Carneggie, D.M. (Geological Survey, Sioux Falls, SD). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51314 (CONF-770478—P1, pp 791-794) **Quaternary geologic map of Minnesota.** Goebel, J.E. (Univ. of Minnesota, St. Paul). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51315 (CONF-770478—P1, pp 729-730) **Digital analysis of LANDSAT data for surveying natural resources in western Sudan.** Baumgardner, M.F. (Purdue Univ., West Lafayette, IN); Kristof, S.J.; Yagoub, Y. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. I.

51316 (CONF-770478—P2, pp 873) **NASA/Cousteau ocean bathymetry experiment.** Polcyn, F.C. (Environmental Research Inst. of Michigan, Ann Arbor). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51317 (CONF-770478—P2, pp 955) **Application of remote sensing to the siting of the Warm Springs Dam, Somona County, California.** Reed, R. (Dames and Moore, Cranford, NJ). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51318 (CONF-770478—P2, pp 991-992) **Late Wisconsinan deglaciation of the northern Midwest interpreted from a springtime LANDSAT color mosaic.** Lucas, J.R. (Technicolor Graphic Services, Inc., Sioux Falls, SD); Taranik, J.V. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51319 (CONF-770478—P2, pp 1065) **Impact of environmental information from LANDSAT to petroleum exploration in the Gulf of Alaska.** Miller, J.M. (Univ. of Alaska, Fairbanks). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51320 (CONF-770478—P2, pp 1077) **SUYUZ-22 mission: part of a complex investigation of earth resources in USSR and GDR.** Siman, J.L.; Bischoff, K. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51321 (CONF-770478—P2, pp 1079) **Data processing for NASA's first space based synthetic aperture radar.** McCandless, S.W. Jr. (National Aeronautics and Space Administration, Washington, DC). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51322 (CONF-770478—P2, pp 1397) **Satellite-to-ground transmissions for amateurs and professionals.** Popham, R.W. (National Environmental Satellite Service, Washington, DC). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51323 (CONF-770478—P2, pp 1543-1544) **Preliminary lineament map of the conterminous United States.** Carter, W.D. (Geological Survey, Reston, VA); Lucchitta, B.K.; Schaber, G.G. 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51324 (UCRL—52413) **Impedance camera: a system for determining the spatial variation of electrical conductivity.** Lytle, R.J.; Dines, K.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jan 1978. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

A data collection and data interpretation method is presented for predicting, from measurements made on the periphery of the core sample, the electrical conductivity distribution within core samples. This method uses an array of electrodes on the periphery to probe through the core sample. Surprisingly accurate detail can be seen in the estimated conductivity distribution. This method has been demonstrated using synthetic examples modeled and analyzed on a computer. Extensions of the procedure may be useful in subsurface geophysical probing and remote probing methods using physical phenomena satisfying Laplace's equation.

51325 Shear wave velocity structure in the earth from differential shear wave measurements. Uhrhammer, R.A. Berkeley, CA; Univ. of California (1977). 180p. University Microfilms Order No. 77-31,570. Thesis (Ph. D.).

Bounds for the shear wave velocity structure in a spherically averaged earth were estimated using differential S minus P (S-P) travel time measurements and detailed statistical procedures. Three methods for reducing the effects of systematic errors in the S travel times were used: (i) adjusting observed differential S-P times to account for the effects of ellipticity and hypocentral depth; (ii) weighting the equations of condition to reduce the effects of non-random distributions of seismographic stations and epicenters on the earth's surface and effects of non-random azimuthal distribution of stations and epicenters; and (iii) simultaneously estimating azimuthally dependent source and station adjustments along with the cubic spline coefficients which were used to represent the differential S-P travel times. Statistical tests were constructed, using analysis of dispersion on a sphere, to determine if the selected stations and epicenters are randomly distributed on the earth's surface. Statistical tests were also constructed to test if the azimuthal distributions of the stations about the epicenters and vice versa are random. Constrained linear least-squares were used to solve for all of the unknown parameters (square adjustments, station adjustments, and cubic spline coefficients) simultaneously. The covariance matrix was analyzed for significant correlations between the parameters in the solution. The S travel times (referenced to surface focus on a sphere) were estimated by adding the differential S—P travel time model to the 1968 P travel times for surface focus as a function of distance. The standard Herglotz-Wiechert-Bateman integral inversion technique was used to estimate the S velocity distribution which represents a spherically averaged earth. A simple method was developed (apparently for the first time in this form) to estimate the approximate variance of the S velocity distribution from the variance of the S slowness model. (JGB)

51326 Three-dimensional numerical modelling in resistivity and IP prospecting. Bakbak, M.R. Berkeley, CA; Univ. of California (1977). 136p. University Microfilms Order No. 77-31,275. Thesis (Ph. D.).

A new type of numerical solution for the apparent resistivity and induced polarization (IP) responses of a three-dimensional inhomogeneity in a conductive half-space, when a polar or dipolar source of direct current is applied on the surface, is presented. The Maxwell-Wagner effect is the physical basis of the integral formulation of the three-dimensional electric boundary value problem. This physical phenomenon allows the inhomogeneity to be replaced by a surface of charge distribution. A numerical scheme based on the finite-element method is used to solve the inhomogeneous integral equation for the cases of rectangular prismatic-shaped bodies. The integral equation is reduced to a matrix equation, which is solved numerically for the charge density function. Then, the potential distribution on the surface of the ground is calculated by integrating over the surface charge density. The solution is used to construct anomaly patterns of apparent resistivity and induced polarization responses for different electrode configuration. Application of the method to study the detectibility of buried inhomogeneities shows that the dipole—dipole array gives overall little stronger response than the pole-dipole, roving pole-dipole, and roving dipole—dipole arrays. Maximum induced polarization response occurs when the inhomogeneity has a conductivity contrast between one and five with respect to the half space. Moving the apparent resistivity and induced polarization line of measurement off the center of the inhomogeneity produces an effect similar to increasing the depth of burial. Apparent resistivity and induced polarization responses of a body six units or greater in strike-length approaches that of an infinite strike length.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

51327 Strain rate dependence in dolomite inferred from impact and static compression studies. Grady, D.E. (Sandia Labs., Albuquerque, NM); Hollenbach, R.E.; Schuler, K.W.; Callender, J.F. *J. Geophys. Res.;* **82**: No. 8, 1325-1333(10 Mar 1977).

Plate impact techniques and laser interferometry instrumentation were used to obtain continuous one-dimensional compression wave data through states of loading and unloading on Blair dolomite in the stress range of 0 to 6.5 GPa. These data are used to infer the dynamic stress—strain response. Both the character of the wave propagation and a comparison with quasi-static uniaxial strain data obtained by other workers suggest substantial strain rate dependence in this rock. The dynamic yield stress of 2.5 GPa determined from the wave propagation data was approximately a factor of 10 higher than that observed in the quasi-static data. Wave propagation below 2.5 GPa is suggestive of viscoelastic response, and a nonlinear Maxwell constitutive equation fitted to these data provides a characteristic relaxation time of 0.01 μs. Comparison of dynamic and quasi-static loading data suggests that the large difference in observed yield stress could be the result of a transition from failure by brittle fracture to failure by intracrystalline plastic flow.

GEOCHEMISTRY

51328 Geochemistry of nitrogen in ground waters of oil-gas-bearing basins. Zor'kin, L.M.; Stadnik, E.V.; Yurin, G.A. *Int. Geol. Rev.;* **19**: No. 12, 1404-1410(Dec 1977).

Translated from Geologiya i Razvedka: No. 2, 88-94(1976).

A review of studies on nitrogen geochemistry shows a correlation between the concentration of nitrogen in the natural gases of the rocks and in the sedimentary strata. It is probable that dispersed organic matter and nitrogen released from the rocks during their metamorphism are the origin of the nitrogen in the natural gas and in the ground water. It is improbable that petroleum decomposition is the origin. (JSR)

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 49527, 51316

51329 (CONF-770478—P2, pp 1415) **Use of synthetic aperture radar for remote sensing of the oceans.** Shuchman, R.A.; Rawson, R.F.; Liskow, C.L.; Larson, R.W.; Liskow, A.R. (Environmental Research Inst. of Michigan, Ann Arbor). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

51330 (COO—2538-17) **Hydrographic processes controlling primary production. Final report.** Yentsch, C.S. (Bigelow Lab. for

Ocean Sciences, Boothbay Harbor, Maine (USA)). 10 Apr 1978. Contract EY-76-S-02-2538. 8p. Dep. NTIS, PC A02/MF A01.

The single most important oceanographic process to phytoplankton kinetics is vertical mixing. Inputs to mix the water column arise from the stress due to the interaction of waters of different densities, stress arising from the movement of water over the bottom, and stress of the wind on the sea. Elaborating the stress due to the interaction of waters of different densities, the best examples occur in major ocean current systems. Here the interaction of two forces, the pressure gradient and the Coriolis force, associated with the horizontal advection, produce a situation which dramatically affects nutrient distribution and phytoplankton production. The Gulf Stream and the Gulf of Maine are cited as examples.

51331 (COO—3563-71) **Radioelement studies in the oceans. Progress report, January 1, 1977—December 31, 1977.** Bowen, V.T. (Woods Hole Oceanographic Institution, Mass. (USA)). Apr 1978. Contract EY-76-C-02-3563. 73p. Dep. NTIS, PC A04/MF A01.

Data are reported on the content of various fallout radionuclides in samples of seawater and sediments collected during 1977 in the Atlantic Ocean, Mediterranean Sea, and Pacific Ocean. Methods used for the preparation of samples for radiometric analysis are described briefly. Radionuclides found included ^{137}Cs, ^{134}Cs, ^{242}Cm, ^{244}Cm, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am. A list is included of publications during the time period covered by this report.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

51332 (LBL—6738) **Ames collaborative study of cosmic-ray neutrons. II. Low- and mid-latitude flights.** Stephens, L.D.; McCaslin, J.B.; Smith, A.R.; Thomas, R.H.; Hewitt, J.E.; Hughes, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). 1 Mar 1978. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

The continuing progress of the Ames Collaborative Study of Cosmic Ray Neutrons is described. Data obtained aboard flights from Hawaii at altitudes of 41,000 and 45,000 feet, and in the range of geomagnetic latitude 17°N less than or equal to lambda less than or equal to 21°N are reported. Preliminary estimates of neutron spectra were made.

51333 (ORNL-tr—4609) **Meteorite "Harvard University", a newly discovered Lodranite-like "mesosiderite".** Ramdohr, P.; Goresy, A.E. Translated by S.D. Blalock Jr. from *Chem. Erde;* **26**: 1-10(1967). 9p. Dep. NTIS, PC A02/MF A01.

A short description of a recently discovered meteorite of a very unusual type, with relations to pallasites and mesosiderites resp. It is a fragment of originally less than 40 g, without a trace of the fusion crust. Containing about 50% in kamacite (+ troilite) and 50% in silicates, it belongs to the mesosiderites senso lato. The silicates consist of olivine in large, partly rounded euhedral grains, bronzite, plagioclase, these three in about equal amounts, and a component of very low refractive index, stated with microsonde to be tridymite. This assemblage is very near to the extremely rare type "lodranite". The minor constituents: chromite, ilmenite and rutile in their properties correspond exactly with these minerals occurring in mesosiderites of the type Vaca Muerta.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

REFER ALSO TO CITATION(S) 51336

51334 **Observational model of the ionized gas in Seyfert and radio-galaxy nuclei.** Osterbrock, D.E. (Univ. of Minnesota, Minneapolis). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 2, 540-544(Feb 1978).

Equivalent widths of the total emission-line Hβ in Seyfert 1, Seyfert 2, and intermediate-type Seyfert galaxies, expressed in terms of the featureless continuum, all have approximately the same frequency distribution. This suggests that the energy-input mechanism to both the narrow-line, low density gas and the broad-line, high density gas is photoionization by the featureless continuum. The reason for the weakness of the narrow emission lines in extreme Seyfert 1 galaxies is then the absorption of most of the ionizing photons in the dense gas near the central source. The statistics of line widths can be fitted by a model in which the dense gas has typical rotational velocity 5000 km/sec and typical turbulent velocity 2000 km/sec. A model is proposed in which the dense gas forms a rotating, turbulent disk with dimension approximately equal to 0.1 pc and height/diameter approximately equal to 2/5. Seyfert 2 galaxies are objects with little dense gas, and intermediate-type Seyfert galaxies are objects in which the dense gas is optically thin to ionizing radiation at least along the poles. Most radio galaxies have strong narrow emission lines, suggesting that escape of radio plasma can only occur where some ionizing photons can also escape from the dense gas. Other predictions, implications, and tests of this model are discussed.

GALAXIES

REFER ALSO TO CITATION(S) 51334

51335 **Chemical compositions of Magellanic clouds' HII regions based on photoelectric spectrophotometry.** Aller, L.H. (Univ. of California, Los Angeles); Czyzak, S.J.; Keyes, C.D. *Proc. Natl. Acad. Sci. U.S.A.;* **74**: No. 12, 5203-5206(Dec 1977).

Detailed line intensity measurements secured at Cerro Tololo Interamerican Observatory and corrected for interstellar extinction are presented for 19 HII regions in the Large Magellanic cloud and 6 in the small Magellanic cloud. The elemental abundances derived by simple methods appear to be in good accord with those found by other observers.

COSMOLOGY

51336 **Observational validation of the chronometric cosmology: the redshift-magnitude relation for quasi-stellar objects.** Nicoll, J.F.; Segal, I.E. (Massachusetts Inst. of Tech., Cambridge). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 2, 535-539(Feb 1978).

A statistical study is made of the redshift-magnitude relation for a recent comprehensive catalogue of quasi-stellar objects. The chronometric theory, although devoid of free parameters such as the q_0 and Lambda of the expansion theory, provides an excellent fit to the observed relation. The expansion theory does not provide an empirically meaningful fit.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

51337 **Ab initio effective core potentials including relativistic effects. II. Potential energy curves for Xe_2, $Xe^+{}_2$, and $Xe^*{}_2$.** Ermler, W.C.; Lee, Y.S.; Pitzer, K.S.; Winter, N.W. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **69**: No. 3, 976-983(1 Aug 1978).

Potential energy curves for the ground $^1\Sigma^+$/sub g/ state of Xe_2, the first four states of the $Xe^+{}_2$ ions, and the eight $Xe^*{}_2$ excimer states corresponding to the addition of a 6sσ/sub g/ Rydberg electron to these ion cores have been computed using averaged relativistic effective core potentials (AREP) and the self-consistent field approximation for the valence electrons. The calculations were carried out using the LS-coupling scheme with the effects of spin—orbit coupling included in the resulting potential energy curves using an empirical procedure. A comparison of nonrelativistic and averaged relativistic EP's and subsequent molecular calculations indicates that relativistic effects arising from the mass—velocity and Darwin terms are not important for these properties of Xe_2 molecules. Spectroscopic constants for $Xe^+{}_2$ are in good agreement with all electron CI calculations suggesting that the computed values for $Xe^*{}_2$ excimers should be reliable. The lifetime for the O/sub u/$^+$ state of the $Xe_2{}^*$ is computed to be 5.6 nsec which is in the range of the experimentally determined values.

51338 **Investigation of the multiple-photon dissociation of SF_5Cl with a real time chlorine-atom diagnostic.** Karl, R.R. Jr.; Lyman, J.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 3, 1196-1199(1 Aug 1978).

Flowing samples of SF_5C1 and SF_5C1+H_2 were irradiated with 6 J/cm^2 of pulsed CO_2 radiation in an apparatus with real time chlorine-atom detection capabilities. The experiments were designed to determine if multiple-photon absorption by a sulfur—fluorine stretching oscillation resulted in the cleavage of the weaker sulfur—chlorine bond. It was shown that chlorine atoms are produced in high yield and that the appearance time was shorter than the mean time between collisions. From the known $C1+H_2$ reaction rates the temperature in the photolysis zone was deduced to be 186°C, thus guaranteeing that the reaction is not thermal.

51339 **Collisionless multiple photon excitation of SF_6: A comparison of anharmonic oscillators with and without octahedral splitting in the presence of rotational effects.** Ackerhalt, J.R.; Galbraith, H.W. (Theoretical Division, University of California, Los Alamos Scientif-

ic Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 3, 1200-1206(1 Aug 1978).

We reinvestigate the importance of octahedral splitting in multiple photon absorption by SF_6 gas in view of the recent measurement and analysis of the $3\nu_3$ spectrum by Kildal. A simple anharmonic oscillator model which includes rotational effects to first order is an excellent approximation to the more complicated octahedral splitting model. Indeed it is the rotational splittings which are essential to the physics of multiple photon absorption modeling.

51340 Electronic structure of Ni— and Ni_2—ethylene cluster complexes. Basch, H.; Newton, M.D.; Moskowitz, J.W. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *J. Chem. Phys.;* **69**: No. 2, 584-597(15 Jul 1978).

The electronic structure of metal cluster—ethylene complexes has been investigated by carrying out ab initio bonding pair-correlated, self-consistent field, and configuration interaction (CI) calculations on the NiC_2H_4 and $Ni_2C_2H_4$ species. The π-NiC_2H_4 and π-$Ni_2C_2H_4$ cluster complexes are found to be bound, the former only with CI, while diσ-$Ni_2C_2H_4$ has only a repulsive Ni_2—C_2H_4 ground state potential curve. The bonding in the π-type cluster complexes can be described as follows: The metal atom configuration is $3d^94s^1$ with the 4s hybridized (by the metal 4p) away from the ethylene molecule, thereby allowing the π orbital to form a dative σ bond with the metal atom. The bonding interaction is promoted by the presence of a second nickel atom behind the first one, leading to a 4s orbital electron deficiency of the bonded nickel atom and thus making this nickel atom a better electron acceptor. Back donation from the occupied metal 3d into the ethylene π^* molecular orbital also takes place to some extent, and thus both features of the classical Dewar—Chatt—Duncanson model are observed. The π-$Ni_2C_2H_4$ species is analyzed in terms of the addition of a bare nickel atom to a π-NiC_2H_4 cluster complex, with concomitant stabilization of the orbitals of the bonded nickel atom. A study of the excited electronic states of π-NiC_2H_4 shows that low-lying $4s\rightarrow\pi^*$ and $3d\rightarrow\pi^*$ (M→L) charge transfer transitions are predicted. The former is not observed experimentally, probably due to the diffuse nature of the 4s orbital. The relationship between small cluster—ethylene complex systems and ethylene chemisorption on a nickel metal surface is discussed.

51341 Potential constants of CF_4. Jones, L.H.; Kennedy, C.; Ekberg, S. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 2, 833-838(15 Jul 1978).

The infrared spectra of the ^{12}C, ^{13}C, and ^{14}C isotopic species of CF_4 have been observed at a resolution of 0.06 cm^{-1}. In addition to the fundamentals ν_3 and ν_4 a number of combination bands have been observed. Using these results, combined with Raman data in the literature, we have calculated the quadratic valence force field, in terms of force constants as well as compliance constants, with considerably better precision than previously obtained. Interaction displacement coordinates have been calculated and show that stretching one CF bond leads, for minimum energy near equilibrium, to opening up of the angles between the other three bonds as well as to their contraction.

51342 K-shell photoabsorption spectra of N_2 and N_2O using synchrotron radiation. Bianconi, A.; Petersen, H.; Brown, F.C.; Bachrach, R.Z. (Stanford Synchrotron Radiation Laboratory, Department of Applied Physics, Stanford University, Stanford, California 94305). *Phys. Rev., A;* **17**: No. 6, 1907-1911(Jun 1978).

The total photoionization cross section of the 1s level of nitrogen in N_2 and N_2O molecules has been measured using monochromatized synchrotron radiation. High-resolution spectra in the range $390 < h\omega < 450$ eV were recorded. A broadband in the continuum at 9.4 eV above the ionization threshold, due to the f-type shape resonance, has been measured with high resolution. The data are compared with theoretical calculations of photoionization cross section. Recent Hartree-Fock calculations in the static-exchange approximation agree better than earlier results, which employed the multiple-scattering method.

51343 Theoretical oscillator strengths for the resonance transitions in the Zn I isoelectronic sequence. Fischer, C.F.; Hansen, J.E. (Department of Computer Science, The Pennsylvania State University, University Park, Pennsylvania 16802). *Phys. Rev., A;* **17**: No. 6, 1956-1965(Jun 1978).

Nonrelativistic gf values for the $4s^2\ ^1S$-$4s\ 4p\ ^1P$ transition based on multiconfiguration Hartree-Fock wave functions are reported for a number of ions from Zn I to W XlV. In addition to the correlation among the outer electrons, the effects of core polarization associated with the $3d^{10}$ subshell are taken into account to first order. Relativistic effects are estimated by using observed energies and allowing for spin-orbit interactions. When only the correlation among the outer electrons is taken into account, these approximate relativistic gf values agree well with relativistic calculations published recently, which also include only outer-shell correlation. The final values are compared with experimental observations. It is found that the discrepancy between theory and experiment is reduced by taking core polarization into account, and that there is good agreement for Zn I. However, for the heavier ions a discrepancy remains which increases with increasing ionization to a factor of 2 in Kr VII. Possible reasons for this discrepancy are discussed.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 50704, 50762

51344 Desorption of neutral molecules from Al(6061) by electron and ion bombardment. Edwards, D. Jr. (Brookhaven National Laboratory, Upton, New York 11973). *J. Vac. Sci. Technol.;* **15**: No. 4, 1586-1596(Jul 1978).

The desorption of neutral molecules by ion (1000-eV Ar^+) and electron (500 eV) impact on aluminum 6061 surfaces is reported. The molecular desorption yields are determined for the following aluminum treatments: (1) samples prepared with nominally the same laboratory treatments; (2) two types of wet chemistry treatments; (3) various in situ gas exposures (including HCl, Cl_2); (4) glow discharge treatments. In summary, it is found that the various prevacuum treatments have little influence on the desorption yields whereas the in situ Cl_2 exposure markedly reduces both the ion and electron desorption yields. In addition, the unit yield energy, E_0, is also measured for the above sample conditionings. It is similarly found that neither the prevacuum sample conditionings nor the in situ gas exposures (with the exception of Cl_2) affect E_0 by more than 10% whereas the in situ Cl_2 exposure (1 atm, 10 min) increases E_0 by a factor of 2 and provides an example illustrating the possible utility of an in situ chemical treatment for the conditioning of vacuum surfaces of large-scale devices.

51345 Surface and vacuum physics index. Thesaurus, 1978. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1978). 20p.

This thesaurus is purely and simply a list of keywords which does not conform to any particular hierarchy such as decimal classification. (MOW)

51346 Production of an intense microsecond electron beam in a gun with a plasma anode. Iremashvili, D.V.; Osepashvili, T.A.; Kakuchaya, P.I. *Sov. Tech. Phys. Lett. (Engl. Transl.);* **3**: No. 12, 512-513(Dec 1977).

The pulse length and propagation velocity of electron beams from a high-current electron gun are studied as functions of the anode-cathode separation.

51347 Cathode sputtering of porous lanthanum hexaboride. Morozov, V.V.; Kresanov, V.S.; Shlyuko, V.Y. (Kiev Polytechnical Institute). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **22**: No. 12, 1465-1467(Dec 1977).

The sputtering rates of LaB by Ar ions and air ions were measured as a function of porosity.

ATOMIC AND MOLECULAR PROPERTIES

51348 Infrared spectra of matrix-isolated plutonium oxides. Green, D.W.; Reedy, G.T. (Chemical Engineering Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **69**: No. 2, 544-551(15 Jul 1978).

The infrared absorption spectra of PuO and PuO_2 in both Ar and Kr matrices have been identified. The observed frequencies at 794.25 and 786.80 cm^{-1} have been assigned to the ν_3 stretching modes of $Pu^{16}O_2$ in Ar and Kr matrices, respectively. Normal coordinate analysis of the PuO_2 isotopomers, $Pu^{16}O_2$, $Pu^{16}O^{18}O$, and $Pu^{18}O_2$, in Ar showed that the molecule is linear. The derived stretching force constants are f=5.2476 +- 0.0010 and f'=0.0034 +- 0.0010 mdyn A^{-1}. The PuO molecule exists in multiple sites in Ar matrices, but not in Kr matrices. The observed $Pu^{16}O$ vibrational frequency in the most stable site in Ar is 822.28 cm^{-1} and in Kr is 817.27 cm^{-1}. No absorption peaks were observed that could be assigned to PuO_3.

51349 Infrared spectra of matrix-isolated plutonium nitrides. Green, D.W.; Reedy, G.T. (Chemical Engineering Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **69**: No. 2, 552-555(15 Jul 1978).

The infrared stretching frequencies of $Pu^{14}N$ and $Pu^{15}N$ in solid Ar at 20 K have been measured as 855.73 and 828.62 +- 0.05 cm^{-1}, respectively. The calculated harmonic frequency ω/sub e/ is 861.9 +- 1.6 cm^{-1} and the first anharmonic correction ω/sub e/x/sub e/ is 3.1 +- 0.8 cm^{-1}. The frequencies of the ν_3 stretching modes of $Pu^{14}N_2$, $Pu^{14}N^{15}N$, and $Pu^{15}N_2$ were measured (+- 0.05 cm^{-1}) as 1029.74, 1017.73, and 998.87, respectively. The plutonium dinitride molecule is linear.

51350 Experimental determination of the structure of H_3^+. Gaillard, M.J.; Gemmell, D.S.; Goldring, G.; Levine, I.; Pietsch, W.J.;

Poizat, J.C.; Ratkowski, A.J.; Remillieux, J.; Vager, Z.; Zabransky, B.J. (Institut de Physique Nucleaire, Universite Claude Bernard Lyon I, 43 Boulevard du 11 Novembre 1918, 69621 Villeurbanne, France). *Phys. Rev., A;* **17**: No. 6, 1797-1803(Jun 1978).

Three different measurements on the structure of the H_3^+ molecular ion are reported. The measurements all make use of a new technique: the foil-induced dissociation of a fast molecular-ion beam. It is shown that the structure is equilaterally triangular in shape. The most probable length of side of the triangle is determined by the three measurements to be 0.97 +- 0.03 A, 0.95 +- 0.06 A, and 1.2 +- 0.2 A, respectively.

51351 (SLAC-Trans—180) **Observation of nonconservation of parity in atomic transitions.** Barkov, L.M.; Zolotorev, M.S. Translated from *Pis'ma Zh. Eksp. Teor. Fiz.;* **26**: 379-383(20 Mar 1978). 11p. Dep. NTIS, PC A02/MF A01.

The effect of nonconservation of parity in atomic transitions was detected. The rotation of the plane of light polarization was measured at the components of the hyperfine structure splitting of the 6477 A line of bismuth.

51352 **Investigation of the interaction of 2^3S_1 metastable He atoms with H_2 molecules by the method of optical orientation of the atoms.** Zhitnikov, R.A.; Kartoshkin, V.A.; Klement'ev, G.V. (A. F. Ioffe Physicotechnical Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 9, 496-498(5 Nov 1977).

Optical orientation of helium atoms was used to investigate the reaction of ionization of molecular hydrogen by 2^3S_1 metastable helium atoms. The temperature dependence of the total ionization cross section is determined in the temperature interval 77—300 K. It is established that this cross section decreases sharply with decreasing temperature.

51353 **Luminescence of hexavalent uranium ions in different crystalline matrices.** Onopko, D.E.; Pashina, E.P.; Starostin, N.V. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **43**: No. 5, 533-535(Nov 1977).

The luminescence of hexavalent uranium ions in various crystal matrices is considered. The characteristics of UO_2, UO_4, and UO_6 uranates have been calculated on the basis of the MO LCAO method and an ion model approximation. The results for the three indicated types of complexes are compared, and the conclusion is drawn that the green luminescence of the uranium ion is apparently associated with the linear group $UO^{2+}{}_2$

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

REFER ALSO TO CITATION(S) 51449

51354 **Energy spectrum of stopping negative mesons and the concentration dependence of capture fractions.** $\theta_7\Lambda\Omega Y$ $\upsilon\rightleftharpoons$ $\leqq\theta\Lambda\mu$ $\cong\gamma_3\Delta\Lambda\mu$ $\int_5{}^+{}_7\Omega\pi^+{}_8{}^+{}_5$ $\theta_{34}\Lambda\omega_3\pi\Lambda\omega\bullet Y$ $\theta\Lambda\mu$ $\cong\gamma_3\Delta\Lambda\mu Y$ $\sigma_7{}'$ $\upsilon_7{}''{}^+{}_5\Lambda$ $^{87545}\geqq\rightleftharpoons$ $\approx=\bullet\mu\rightleftharpoons$ $\}_7\Xi\rightleftharpoons Y$ $\cong\rightarrow$ $^{17}\ni$ $\sigma\Lambda\rightleftharpoons$ ^6Y $^{2112}\supset{}^{2118}\leqq\lambda\Sigma\Omega$ $^{1978}\geqq\rightleftharpoons$

The physics that determines the shape of the energy spectrum of stopping negative mesons is discussed. We note that a white energy spectrum, for arrival probability F(E), not flux P(E), follows for a large class of models. The importance of distinguishing between F(E) and P(E) is stressed: (E) reflects the energy (E) dependence of the total inelastic and capture cross sections, while F(E) is independent of these. The F(E) proportional E behavior found in some models is due to meson capture at positive energies, i.e., capture behind a positive centrifugal barrier. We explore the possibility of a concentration effect on capture ratios in binary mixtures, and conclude that, as long as the energy losses in meson-atom collisions are not much smaller than the barrier height, such concentration effects are negligibly small.

51355 **Muonic isotope shifts in the stable Ca nuclei.** $>\Lambda=\gamma_{83}=\omega\pi Y$ $\Gamma\rightleftharpoons\Theta\rightleftharpoons\rightarrow$ $\int=_7\omega_3 Y$ $\sim\rightleftharpoons\infty\rightleftharpoons\rightarrow$ $\Gamma\Lambda_7=\Omega Y$ $\upsilon\rightleftharpoons+\rightleftharpoons\rightarrow$ $_{13}\Delta_3\bullet_3\beta^+Y$ $_1\rightleftharpoons$ $\leqq\theta\Lambda\mu$ $\cong\gamma_3\Delta\Lambda\mu$ $\int_5{}^+{}_7\Omega\pi^+{}_8{}^+{}_5$ $\theta_{34}\rightleftharpoons Y$ $\sigma\rightleftharpoons\upsilon_7{}''\rightleftharpoons$ $\leqq<\int\cong\geqq\rightarrow$ $\delta\omega^+{}_5\beta_7 Y$ $\ni\rightleftharpoons$ $\leqq\upsilon_3{}^+\Omega\bullet$ $<\Omega^+\Xi\rightleftharpoons$ $\leqq\partial_7\omega\Delta_3\Omega\bullet Y$ $\delta\rightleftharpoons\}\rightleftharpoons\geqq\rightleftharpoons$ $\kappa\Omega\mu\pi\rightleftharpoons$ $_8\Sigma_7\omega$ $o_7\omega\Omega^-=\bullet\mu^+\beta\geqq\rightarrow$ $\int\pi_{7887}\Omega Y$ $\}\rightleftharpoons\upsilon\rightleftharpoons$ $\leqq\approx\Sigma\omega_6\Sigma_7$ $<\Omega^+\Xi\rightleftharpoons Y$ $\theta_{383}\bullet_7\pi\pi_7 Y$ $\kappa\Omega_6\rightleftharpoons$ $\leqq<\int\cong\geqq\rightleftharpoons\Theta_7{}^-\pi\rightleftharpoons\Lambda_8\approx=\bullet\mu^+{}_5\mu\geqq\rightleftharpoons\approx=\bullet\mu\rightleftharpoons\theta_7\pi\pi\rightleftharpoons Y$ $\infty\rightarrow$ $^{73}\ni\sigma\Lambda\rightleftharpoons{}^7Y$ $^{131}\supset{}^{134}\leqq{}^{13}\delta_{74}$ $^{1978}\geqq\rightleftharpoons$

Precise isotope shifts of the 2p-1s muonic transition energies for the stable Ca isotopes have been measured. Model-independent radius differences are derived from combined analysis of the present data and elastic electron scattering data. The precise new $^{48-40}Ca$ isotope shift disagrees with Hartree-Fock predictions.

51356 **Influence of s electrons of the outer shell on the rate of the conversion transition between hyperfine-structure states in the "nucleus" of a mu-nucleon atom.** Gorelkin, V.N. (Moscow Physico-technical Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 192-196(Aug 1977).

An external magnetic field affects the rate of conversion Auger transition between states of the hyperfine structure of a mesic atom with the ejection of an electron from the outer paramagnetic s shell of the mu-nucleon atom. This effect can be used to measure the difference between the rates of K capture of a μ^- meson from states with different total spin I=i +- 1/2 of the mesic atom, which is determined by the Gamow-Teller and Fermi weak-interaction constants.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 50727

51357 (COO—2640-6) **Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1977—April 30, 1978.** Gentry, W.R. (Minnesota Univ., Minneapolis (USA)). Jan 1978. Contract EY-76-S-02-2640. 17p. Dep. NTIS, PC A02/MF A01.

A program of research was undertaken to study the dynamics of the reactions of ions with atomic and molecular free radicals, using a merged molecular beam technique. The objectives of this research are to obtain fundamental information on reaction mechanisms in reactions of species having open-shell electronic configurations, and to investigate the importance of electronic nonadiabaticity in chemical reactions. During the past contract year $D_2^+ + O(^3P) \rightarrow OD^+ + D$ and $D_2^+ + C(^3P) \rightarrow CD^+ + D$ over the range of initial relative kinetic energy from 0.002 eV to 27 eV were completed. In order to interpret this and future data, also a theoretical study of the long-range interactions of ions with open-shell atoms was performed, permitting quantitative description of the effect of the atomic quadrupole moment on the low energy reaction cross section, and to determine the influence of the electronic orbital angular momentum projection quantum number of the reactivity.

51358 **Electron capture and loss cross sections for multicharged iron and argon ions in argon and molecular hydrogen.** Berkner, K.H.; Graham, W.G.; Pyle, R.V.; Schlachter, A.S.; Stearns, J.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 542-543 of International conference on the physics of electronic and atomic collisions. Vol. I. Paris; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

51359 **Threshold behavior for collision-induced dissociation of CsCl and Cs_2Cl_2 by SF_6 molecules.** Parks, E.K.; Sheen, S.H.; Wexler, S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **69**: No. 3, 1190-1195(1 Aug 1978).

Absolute cross sections have been determined for collision-induced dissociation of cesium chloride (monomer and dimer) from collisions with SF_6 molecules. SF_6 was aerodynamically accelerated in H_2 to laboratory energies up to 11 eV. Mass analysis of the product ions indicate the occurrence of the reactions (a) $SF_6+CsCl\rightarrow SF_6+Cs^+ +Cl^-$, (b) $SF_6+Cs_2Cl_2\rightarrow SF_6+Cs_2Cl^+ +Cl^-$, (c) $SF_6+Cs_2Cl_2\rightarrow SF_6+Cs^+ +CsCl_2^-$. The absolute cross sections for these reactions were determined from threshold to approximately 2 eV above threshold. In this energy region, the cross sections were accurately represented by a power law, $\sigma=A_0$ x (E/ sub tot/-E_0)/sup n//E/sub rel/, where E/sub tot/ is the total energy, E_0 the threshold energy, and E/sub rel/ the relative kinetic energy. Values for A_0 for Reactions (a) and (b) are approximately an order of magnitude smaller than for the analogous reactions with Xe, while A_0 for Reaction (c) is a factor of 3 smaller. In spite of the molecular character of the projectile the thresholds for Reactions (a) and (b) are very near those observed in the case of Xe. For Reaction (c), however, the threshold is about 1 eV higher. The powers n obtained for the above reactions are all about 1.0 higher than those obtained for the reactions with Xe. This effect, in particular, most likely arises from the SF_6 internal degrees of freedom which absorb energy in the collision.

51360 **Spectra of the collision-induced emission from $S(^1S)$.** Black, G.; Sharpless, R.L.; Slanger, T.G. (Molecular Physics Laboratory, SRI International, Menlo Park, California 94025). *J. Chem. Phys.;* **69**: No. 2, 794-799(15 Jul 1978).

The spectra of collision-induced emission from $S(^1S)$ in collisions with He, Ar, N_2, H_2, Kr, and Xe have been measured. The $S(^1S)$ was made by OCS photodissociation with both a xenon resonance lamp (1470 A) and a CO 4+ lamp (1500—1600 A). With all gases except xenon, the most obvious effect on the $S(^1S_0\rightarrow{}^3P_1)$ transition at 4590 A is the appearance of a neighboring "line" at 4508 A corresponding to the $S(^1S_0\rightarrow{}^3P_2)$ transition. No evidence of the $S(^1S_0\rightarrow{}^3P_0)$ transition at 4628 A is seen. Xenon does not produce the 4508 A emission but results in the appearance of a blue degraded band extending from the 4590 A line. All of the gases produce a blue degraded band on the $S(^1S_0\rightarrow{}^1D_2)$ transition at 7727 A. The implications of these results for the potential curves of XeS are discussed.

51361 Ab initio calculation of the vibrational energy transfer rate of H_2 in Ar using Monte Carlo classical trajectories and the forced quantum oscillator model. Blais, N.C.; Truhlar, D.G. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 2, 846-854(15 Jul 1978).

We calculate the rotationally equilibrated vibrational excitation rate for parahydrogen in argon from 1620 to 4500 °K. We use the most accurate available potential energy surface and the well tested classical-trajectory forced quantum oscillator method. We find the temperature dependence is not well fit by the popular Landau—Teller functional form. We find a large effect of initial rotational excitation which is not necessarily associated with rotational to vibrational energy transfer. To the extent that our rates can be used to predict experimentally measured relaxation rates they are about a factor of 3 too large. We also studied two other (less accurate) potential energy surfaces to show the sensitivity of the calculated results to the assumed interaction potential.

51362 Observation of oscillations in the charge dependence of total electron-capture cross sections. Kim, H.J.; Hvelplund, P.; Meyer, F.W.; Phaneuf, R.A.; Stelson, P.H.; Bottcher, C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **40**: No. 25, 1635-1638(19 Jun 1978).

An oscillatory dependence on ionic charge of total electron-capture cross sections has been observed for multiply charged heavy projectiles incident on an atomic hydrogen target. The oscillatory behavior is attributed to interference caused by the long-range Coulomb and a short-range (screened Coulomb) force acting on the captured electron. The oscillations are superimposed on a monotonically increasing variation with ionic charge. This monotonic increase is also found for lighter ions.

51363 Comparison of the Born and Glauber generalized oscillator strengths for the 2s → 3p transition of atomic hydrogen. Chan, F.T.; Chang, C.H.; Lieber, M.; Kim, Y. (Department of Physics, University of Arkansas, Fayetteville, Arkansas 72701). *Phys. Rev., A;* **17**: No. 6, 1869-1873(Jun 1978).

Minima and maxima of the generalized oscillator strength for the 2s → 3p transition of atomic hydrogen are found using the Glauber approximation. In contrast to the first-Born approximation, the number of extrema and their positions are found to vary with the energy of the incident particle, and the values at the minima do not vanish. There is qualitative agreement in the behavior of the first minimum with known experimental data on the resonance transitions of rare gases and mercury. For large incident energy, the transition amplitude in the Glauber approximation falls off with large momentum transfer more rapidly than predicted by a previous calculation based on the second-Born approximation.

51364 Theory of electron—hydrogen-atom collisions in the presence of a laser field. Brandi, H.S.; Koiller, B.; Lins de Barros, H.G.P.; Miranda, L.C.M.; Castro, J.J. (Departamento de Fisica, Pontificia Universidade Catolica, Cx.P. 38071, Rio de Janeiro, RJ, Brazil). *Phys. Rev., A;* **17**: No. 6, 1900-1906(Jun 1978).

Expressions for the scattering amplitude of multiphoton processes occurring during the collision of electrons with a hydrogen atom in the presence of an electromagnetic field have been obtained in several approximations: the momentum translation, the space translation, and the Keldysh approximation for the bound-electron wave function. We also propose a perturbation approach based on the space-translation approximation to treat the hydrogen-atom bound states. Our results show that it is of fundamental importance ot consider the modifications of bound states due to the presence of the field.

51365 Theoretical simulation of beam-foil decay curves for resonance transitions of heavy ions. Younger, S.M.; Wiese, W.L. (Institute for Basic Standards, National Bureau of Standards, Washington, D.C. 20234). *Phys. Rev., A;* **17**: No. 6, 1944-1955(Jun 1978).

A systematic study of the influence of cascades on heavy-ion beam-foil decay curves has been made. Using theoretical data for the lifetimes and initial populations of excited states, decay curves simulating beam-foil excitation conditions have been constructed for the resonance transition of three ions in the copper isoelectronic sequence. Various models for the initial population distribution were tested by comparison with a detailed beam-foil decay curve available for Kr VIII. We found that customary exponential-fitting methods were not able to extract the primary lifetimes from the simulated curves used in constructing them, although the replenishment ratios were close to zero. General implications of this subtle masking of the primary lifetime by numerous cascades for the accuracy of experimental beam-foil data are discussed, especially for $\Delta n = 0$ transitions in heavy ions.

51366 Fine structure of the 1s2s2p ^{4}P/sup o/ and 1s2p^2 ^{4}P doubly excited states in lithium-like carbon, nitrogen, and oxygen. Livingston, A.E.; Berry, H.G. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., A;* **17**: No. 6, 1966-1975(Jun 1978).

The fine structure of the 1s2s2p ^{4}P/sup o/-1s2p^2 ^{4}P multiplet in the doubly excited quartet system of three-electron C IV, N V, and O VI has been measured using the method of beam-foil spectroscopy. The fine-structure splittings have been determined to within ~ 5 cm^{-1} in both the upper and lower states of each ion, and the absolute transition wavelengths have been measured to within ~ 0.1 A (~ 10^{-3} eV). The wavelength results show that existing relativistic and nonrelativistic energy separations calculated for these ^{4}P states are inaccurate by ~ 1% for Z = 6—8, and that calculations of the fine-structure splittings are inaccurate by (10—20) % for 1s2s2p ^{4}P/sup o/ and by > or ≈ 20% for 1s2p^2 ^{4}P. Lifetimes have also been measured for the J = 5/2, 3/2, and 1/2 levels of 1s2p^2 ^{4}P. Differential metastability is found to be a characteristic feature of these core-excited fine-structure states in all three ions. Comparison with calculated autoionization and K x-ray transition rates for Z = 7 and 8 indicates that the 1s2p^2 ^{4}P/sub 5/2/ lifetime is determined essentially by its autoionization rate to the doublet continuum through magnetic interactions, whereas the J = 3/2 and 1/2 states decay at a slower rate that is more characteristic of the ^{4}P/sup o/-^{4}P radiative transition rate.

51367 Projectile-charge dependence of stopping powers. Ritchie, R.H.; Brandt, W. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., A;* **17**: No. 6, 2102-2105(Jun 1978).

Recent stopping-power data of solids with atomic number Z_2 ranging from 13 to 79 for ions ranging in atomic number Z_1 from 1 to 9 and in velocity from $7v_0$ to $12v_0$ are analyzed in terms of Z^3_1 effects and effective ion charges. They are found to be consistent with current theory. High-velocity forms of the Z^3_1-proportional stopping-power contributions are calculated by the method of moment integrals.

51368 Differential elastic electron scattering cross sections for N_2 from 0 to 30 eV. Siegel, J.; Dill, D.; Dehmer, J.L. (Department of Chemistry, Boston University, Boston, Massachusetts 02215). *Phys. Rev., A;* **17**: No. 6, 2106-2109(Jun 1978).

We extend our recent work [Phys. Rev. A 16, 1423 (1977)] on total elastic electron-scattering cross sections for N_2 to include differential cross sections from 0 to 30 eV. Extensive comparisons with the results of experiments and other theories are made. The overall agreement is good, indicating that the multiple-scattering method is capable of providing a realistic first approximation to the electron-molecule interaction. At the same time, small systematic disagreements with experiment indicate clearly the need and objective of future improvements.

51369 Population inversion of 3s states in neon in low-energy collisions with sodium ions. Bobashev, S.V.; Kharchenko, V.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **3**: No. 12, 542-543(Dec 1977).

Cross sections for the 3s-3p cascade transition in NeI are reported.

51370 Electron capture in different electronic states by multiply charged Ar/sup [Z/ ions in He atoms. Afrosimov, V.V.; Basalaev, A.A.; Panov, M.N.; Leiko, G.A. (A. F. Ioffe Physicotechnical Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 10, 537-539(20 Nov 1977).

It was found experimentally that the cross section for the capture by the ions Ar/sup [Z/ (Z=3—7) is (1—2) x 10^{-15} cm^2. There is no monotonic dependence of the cross section on Z. The ions Ar/sup([Z/-1) are produced only in excited states, while the number of the states populated upon capture is small (2—3).

51371 Effective cross sections for electron-impact excitation of resonant lines of singly charged europium ions. Shimon, L.L.; Garga, I.I.; Golovchak, N.V. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **43**: No. 5, 591-592(Nov 1977).

The method of intersecting beams was employed to study the excitation cross sections of Eu ions.(AIP)

51372 Solution of the two-channel scattering problem by the phase-function method. Faifman, M.P. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 227-231(Aug 1977).

A scheme for solving a system of two coupled Schroedinger equations is developed on the basis of the phase-function method. The method is applicable to calculation of the wave functions that represent the process of scattering of hydrogen mesic atoms by protons.

51373 Ion—molecule reactions in 1,1,2,2-tetrafluorocyclobutane. Ravishankara, A.R.; Eyler, J.R.; Hanrahan, R.J. (Univ. of Florida, Gainesville). *J. Mass Spectrom. Ion Phys.;* **22**: 315-326(1976).

Ion—molecule reactions in the 1,1,2,2-tetrafluorocyclobutane (c-$C_4H_4F_4$) system were studied by using a time-of-flight(TOF) mass spectrometer to obtain kinetic data and an ion cyclotron resonance mass spectrometer to obtain information about the reaction path-

ways. To obtain kinetic data, measurements of the variation of the ion intensities with changes in ion residence time were carried out. The parent ion $C_4H_4F_4^+$ had very low abundance and was found to be nearly non-reactive. However, ion—molecule reactions were observed for several fragment species, particularly the olefinic ions $C_2H_2F_2^+$ and $C_2H_4^+$. It was found that $C_2H_2F_2^+$ becomes the most abundant ion in this system when the pressure is increased. By use of the ion cyclotron double resonance technique, it was established that reaction of $C_2H_2F_2^+$ with parent c-$C_4H_4F_4$ produces the species $C_6H_6F_6^+$ and $C_5H_6F_4^+$. The species $C_4H_2F_6^+$, seen in the TOF instrument but not in the ICR, probably also involves attack of $C_2H_2F_2^+$ on substrate molecules. All three reactions appear to involve a common mechanism: ring opening attack on substrate molecules to give a linear intermediate which may persist ($C_6H_6F_6^+$) or fragment. The rapid disappearance of $C_2H_4^+$ probably involves a similar reaction sequence. 4 figures, 2 tables.

ATOMIC AND MOLECULAR THEORY

51374 Ab initio studies of AuH, AuCl, HgH and $HgCl_2$ using relativistic effective core potentials. Hay, P.J.; Wadt, W.R.; Kahn, L.R.; Bobrowicz, F.W. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 3, 984-997(1 Aug 1978).

Relativistic effective core potentials (ECP) are derived for Au and Hg atoms, where the ECP incorporates the Coulomb and exchange contributions of the core orbitals, the core-orthogonality terms for the valence orthogonality terms for the valence orbitals, and the effect of the "mass—velocity" and "Darwin" relativistic effects on the valence orbitals. The results of atomic valence-electron (VE) calculations with the ECP's compare favorably with relativistic Hartree—Fock and Dirac—Hartree—Fock calculations and with experiment, when the effects of spin—orbit coupling are included in the VE calculations. Nonrelativistic calculations, by contrast, lead to erroneous predictions and to differences in excitation energies of 1.5—3.5 eV. The large relativistic effects in the atoms carry over into the AuH, AuCl, and $HgCl_2$ molecules, as they are important in determining correct bond lengths and bond energies and in influencing the charge distributions. Similarly large relativistic effects are encountered in ionization potentials calculated for $HgCl_2$ from orbital energies and from SCF calculations. Spin—orbit coupling is introduced to compare with the experimental photoelectron spectrum. An extensive study of the lowest electronic states of HgH is presented, where the effects of spin—orbit coupling are critical in describing the potential energy curves of the excited $^2Pi/$ sub $1/2/$ and $2^2\Sigma^+/$sub $1/2/$ states.

51375 Extensions of the complex-coordinate method to the study of resonances in many-electron systems. Rescigno, T.N.; McCurdy, C.W. Jr.; Orel, A.E. (Theoretical Atomic and Molecular Physics Group, Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., A;* **17**: No. 6, 1931-1938(Jun 1978).

Difficulties in the straightfoward application of the complex-coordinate method to the calculation of resonance states in many-electron systems are examined. For the case of shape resonances, it is shown that many of these difficulties can be avoided by using complex coordinates only after reduction of the system to an effective one-electron problem. Further simplifications are achieved by the use of an inner-projection technique to facilitate the computation of the complex Hamiltonian matrix elements. The method is first illustrated by application to a model-potential problem. Its suitability for studying many-electron problems is demonstrated by calculation of the position and width of a low-energy $^2P/$sup o/ shape resonance in Be^-. We discuss the modifications necessary to study core-excited (Feshbach) resonances.

51376 Refined ab initio relativistic electron binding energy and Auger transition-energy calculations. Chen, M.H.; Crasemann, B. (Oregon Univ., Eugene (USA). Dept. of Physics); Aoyagi, M.; Mark, Hans (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). pp 204-205 of International conference on the physics of electronic and atomic collisions. Vol. I. Paris; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

FLUID PHYSICS

REFER ALSO TO CITATION(S) 50655

GENERAL FLUID DYNAMICS

51377 (UCID—17809) **HEMP advection model.** Sharp, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jun 1978. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

The automatic rezoning procedure now being developed for a version of the HEMP code is outlined. HEMP is a two-dimensional, Lagrangian, fluid dynamics code with slide lines and elastic—plastic material strength models. The rezoning procedure is adapted directly from the OOZE code. Cylindrical symmetry is considered. By omission of appropriate radial factors, everything is applicable to plane symmetry. Since the procedure is equivalent to a finite difference solution of the advection term in the generalized fluid dynamics equations, it is often referred to as advection. First, an outline is given of some general physics considerations for the rezoning problem. Next, several changes in the OOZE algorithm are specified. Then a detailed outline of the algorithm developed for HEMP is provided. 7 figures. (RWR)

51378 Vortex sheet approximation of boundary layers. Chorin, A.J. (Department of Mathematics and Lawrence Berkely Laboratory, University of California, Berkely, California, 94720). *J. Comput. Phys.;* **27**: No. 3, 428-442(Jun 1978).

a grid free method for approximating incomprssible boundary layers is introduced. The computational elements are segments of vortex sheets. The method is related to the earlier vortex method; simplicity is achieved at the cost of replacing the Navier-Stokes equations by the Prandtl boundary layer equations. A new method for generating vorticity at boundaries is also presented; it can be used with the earlier voartex method. The applications presented include (i) flat plate problems, and (ii) a flow problem in a model cylinder- piston assembly, where the new method is used near walls and an improved version of the random choice method is used in the interior. One of the attractive features of the new method is the ease with which it can be incorporated into hybrid algorithms.

51379 Partition technique for the solution of potential flow problems by integral equation methods. Harten, A.; Efrony, S. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *J. Comput. Phys.;* **26**: No. 4, 71-87(Apr 1978).

Discretization of integral equation methods for the computation of potential flows results in dense matrices. The partition technique of this paper is designed to remove this restriction on the size of problems that can be efficiently computed by integral equation methods. This technique consists of dividing the domain by partition curves and then applying a standard integral equation method to each of the subdomains. The potential on the partition curves as well as the absolute value of its normal derivative are considered to be additional unknowns. Although the number of unknowns was thus increased, the number of nonzero entries in the matrix of the extended system was considerably reduced. Using a partial elimination process in each of the subdomains, a determined system of equations for the unknowns on the partition curves is automatically derived. Once the latter is solved, the solution in each of the subdomains is obtained by back substitution. The partition technique extends to problems in an unbounded domain with a radiation condition, and can be easily implemented in existing computer programs. To describe the technique, we choose the particular problem of time harmonic motion of floating bodies in two dimensions.

MAGNETOHYDRODYNAMICS

REFER ALSO TO CITATION(S) 50537

SUPERFLUIDITY

51380 Static magnetization of superfluid ^3He. Sager, R.E.; Kleinberg, R.L.; Warkentin, P.A.; Wheatley, J.C. (Department of Physics, University of California: San Diego, La Jolla, California). *J. Low Temp. Phys.;* **30**: No. 9, 409-421(1 May 1978).

New measurements of the static magnetization of ^{3}He-B in contact with a variety of wall configurations are presented and compared with previous measurements in both A and B phases. At high pressure the data tend toward agreement with resonant-magnetism experiments, while near the polcritical point a large discrepancy between the results of the two methods remains.

51381 He^3—He II solutions in strong magnetic fields. Bashkin, E.P.; Meierovich, A.E. (Institute of Physics Problems, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 10, 534-536(20 Nov 1977).

We investigate the properties of a low-density Fermi liquid, such as He^3—He II solutions, in strong magnetic fields, when the spin system is almost fully polarized. The most pronounced effects are connected with the tremendous growth of the kinetic coefficients.

51382 Measurements of the static and dynamic NMR susceptibilities of superfluid ^{3}He—B using an R-F biased SQUID. Webb, R.A.; Sungaila, Z. (Argonne National Lab., IL). pp 127-132 of Quantum fluids and solids. Trickey, S.B.; Adams, E.D.; Dufty, J.W. (eds.). New York; Plenum Publishing Corp. (1977).

By means of an r-f biased SQUID, the temperature-dependent susceptibility of superfluid ^{3}He-B was measured both statically and by a pulse technique in a field of 309 gauss and in a pressure range 26.5 to 18 bar. In ^{3}He-B the dynamic susceptibility as determined by use of pulsed SQUID NMR agrees with the theoretical predictions for the BW state. However, the static susceptibility measured, by use of the same r-f biased SQUID and pick up coil, is significantly smaller than the dynamic susceptibility. 3 figures.

OTHER QUANTUM FLUIDS

51383 Transverse zero sound in normal ^{3}He. Roach, P.R. (Argonne National Lab., IL); Ketterson, J.B. pp 223-231 of Quantum fluids and solids. Trickey, S.B.; Adams, E.D.; Dufty, J.W. (eds.). New York; Plenum Publishing Corp. (1977).

The complex acoustic shear impedance of liquid ^{3}He was measured by observing the decay of a transiently excited ac cut quartz transducer. Comparison with recent theories suggests that the results at low temperatures can be due only to the excitation of transverse zero sound. The direct transmission of transverse excitations between two closely spaced transducers in the vicinity of 3 mK was also observed. These results are analyzed in terms of the propagation of transverse zero sound although theory suggests that a single-particle contribution must also be present. 4 figures.

51384 Preliminary measurements of the low temperature ion mobility in normal liquid ^{3}He. Roach, P.D. (Northwesten Univ., Evanston, IL); Ketterson, J.B.; Roach, P.R. pp 259-264 of Quantum fluids and solids. Trickey, S.B.; Adams, E.D.; Dufty, J.W. (eds.). New York; Plenum Publishing Corp. (1977).

The temperature dependence of the mobility of positive and negative ions in normal liquid ^{3}He between approximately 2.5 mK and 600 mK and at pressures from the vapor pressure to 23 bar are reported. 3 figures.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

51385 Inclusive electron production in multiprong events produced in e^+e^- annihilation. Feller, J.M.; Litke, A.M.; Madaras, R.J.; Ronan, M.T.; Barbaro-Galtieri, A.; Dorfan, J.M.; Ely, R.; Feldman, G.J.; Fong, A.; Gobbi, B.; Hanson, G.; Jaros, J.A.; Kwan, B.P.; Lecomte, P.; Lueke, D.; Martin, J.F.; Miller, D.H.; Parker, S.I.; Perl, M.L.; Peruzzi, I.; Piccolo, M.; Pun, T.P.; Rapidis, P.A.; Ross, R.R.; Scharre, D.L.; Trippe, T.G.; Vuillemin, V.; Yount, D.E. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **40**: No. 26, 1677-1680(26 Jun 1978).

We have measured inclusive electron production in multiprong events produced by e^+e^- annihilation in the center-of-mass energy range 3.9—7.4 GeV. We find the electron momentum spectra are consistent with the electrons coming mainly from decays of charmed particles, with a smaller contribution from decays of the tau lepton. From our data we calculate the average branching ratio for charmed particles to decay into an electron plus additional particles to be (8.2 +- 1.9) %.

51386 Electroproduction of Hadrons from nuclei. Osborne, L.S.; Bolon, C.; Lanza, R.; Luckey, D.; Roth, D.; Martin, J.F.; Feldman, G.J.; Franklin, M.E.B.; Hanson, G.; Perl, M.L. (Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev. Lett.;* **40**: No. 25, 1624-1627(19 Jun 1978).

We have measured the electroproduction of hadrons from nuclei and compare it to the electroproduction from deuterium. We find an attenuation of the forward component which increases with A. The attenuation is less for lower hadronic momenta, but is not a strong function of the other electroproduction variables.

51387 Double polarization experiment in investigation of the reaction $\gamma p \to p\pi^0$ with a beam of linearly polarized photons. Gorbenko, V.G.; Derebchinskii, A.I.; Zhebrovskii, Y.A.; Zybalov, A.A.; Kolesnikov, L.Y.; Konovalov, O.G.; Rubashkin, A.L.; Sorokin, P.V.; Tenishev, A.E. (Khar'kov Physico-technical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 167-171(Aug 1977).

We measured the polarization of the recoil proton in the reaction $\gamma p \to p\pi^0$ with a beam of linearly polarized photons obtained with the aid of coherent bremsstrahlung from a diamond crystal in the Khar'kov linear electron accelerator. The experimental values of the cross-section asymmetry ϵ, of the asymmetry T/sub y/ on a polarized target, and the recoil-proton polarization components P/sub y/ and P/sub x'z' are obtained at a photon energy 500 MeV and at c.m.s. pion-emission angles 105, 120, and 140° and are compared with the predictions of various multipole analyses.

WEAK INTERACTIONS

51388 (ORO—2504-270) **Neutrino-induced heavy lepton pair production at high energies. Technical report No. 78-071.** Bechis, D.J.; Chang, C.Y.; Lau, K.H. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Feb 1978. Contract EY-76-C-05-2504. 12p. Dep. NTIS, PC A02/MF A01.

Total cross sections for the coherent process ν/sub μ/ + $^{56}Fe \to \mu^- + L^+ + L^0 + {}^{56}Fe$ were calculated in conventional V-A four-fermion point-vertex weak interaction theory for muon neutrinos of high energies. Various mass assignments were considered for L^+ and L^0. Some of the cross sections are large enough to give rise to the trimuon and four-muon final states seen at the CERN SPS.

51389 Strength of the antineutrino-proton neutral-current interaction. Derrick, M.; Gregory, P.; Hyman, L.G.; Jaeger, K.; Lissauer, D.; Miller, R.J.; Musgrave, B.; Phelan, J.J.; Schreiner, P.; Singer, R.; Barish, S.J.; Engler, A.; Keyes, G.; Kraemer, R.W.; Kikuchi, T.; Barnes, V.E.; Carmony, D.D.; Garfinkel, A.F.; Laasanen, A. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **18**: No. 1, 7-15(1 Jul 1978).

Using the Fermilab 15-foot hydrogen bubble chamber exposed to a broad-band nu-bar and ν beam, we have studied the neutral-to-charged- current cross-cross ratio R for interactions on protons. The ratio R/sup nu-barp/ is found assuming various forms of the neutral- current couplings. The data are consistent with the predictions of the Weinberg-Salam model and, assuming this model, we obtain R/sup nu-barp/ = 0.42 +- 0.13.

STRONG BARYON-INDUCED INTERACTIONS

51390 (ANL-HEP-CP—78-11) **Resonant-like structures in pp system in the mass region 2100 to 2800 MeV.** Yokosawa, A. (Argonne National Lab., Ill. (USA)). 1978. Contract W-31-109-ENG-38. 16p. (CONF-780338—1). Dep. NTIS, PC A02/MF A01.

From 3. conference on new results in high energy physics; Nashville, TN, USA (6 Mar 1978).

Proton—proton total cross section data at the intermediate-energy region are shown. The structure of these cross sections is discussed. No structure is observed suggesting the possible existence of a resonance. But when both the incident protons and target protons were longitudinally polarized, totally unexpected structures were found, the most remarkable of which appears around 1.5 GeV/c. The main discussion concerns the existence of at least one diproton resonance and its properties, and three more such candidates are speculated. Differential cross sections are also discussed. It is noted that such a resonance opens a new era in the nucleon—nucleon system and also is crucially important for further development of the quark models that require six quarks in a bag. 28 references. (JFP)

51391 Multiplicity distributions and rescattering effects in pd interactions at 200 GeV/c. Dombeck, T.; Hyman, L.G.; Koetke, D.D.; Phelan, J.J.; Singer, R.; Barish, S.J.; Hartner, G.F.; Patel, P.M.; Levman, G.M.; Sreedhar, V.A.; Yoon, T.; Grechko, V.E.; Grishin, V.G.; Kuznetsov, A.A.; Leikin, E.M.; Melnikova, N.N.; Murzin, V.S.; Pozhidaeva, N.A.; Sarycheva, L.I.; Scheglova, L.M.; Shevchenko, V.G.; Smirnova, L.N.; Solomin, A.N.; Jancso, G. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **18**: No. 1, 86-91(1 Jul 1978).

This study determines topological cross sections and rescattering effects for 200-GeV/c pd interactions observed in a 60 000-picture exposure of the Fermilab 30-inch deuterium bubble chamber. We measure the pd inelastic cross section for n/sub ch/ > or = 3 to be 55.0 +- 0.8 mb and find that (17.4 +- 1.8) % of the pn events have a secondary interaction with the spectator proton. The rescattering is adequately described by a model which assumes the rescattering probability to be independent of the primary collision multiplicity. The multiplicity distribution for nonrescattered pn interactions has $\langle n \rangle = 7.3 \pm 0.1$ and f/sup $c/c_2 = 8.4 \pm 0.5$.

51392 Polarization in elastic p-p and p-n scattering at 1.03 GeV. Marshak, M.L.; Peterson, E.A.; Ruddick, K.; Lesikar, J.; Mulera, T.; Roberts, J.; Klem, R.; Talaga, R.; Wriekat, A. (School of Physics,

University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev., C;* **18**: No. 1, 331-336(Jul 1978).

The polarization in elastic proton-proton and proton-neutron scattering has been measured at an incident kinetic energy of 1.03 GeV. The proton-proton data have a significantly higher precision than previously obtained in this energy range and extend into the Coulomb interference region. The proton-neutron measurement is the first in this energy region. The results are compared with existing nucleon-nucleon phase shifts solutions.

51393 Measurement of the transverse spin dependence of the pp total cross section in the 1-3 GeV/c region. Biegert, E.K.; Buchanan, J.A.; Clement, J.M.; Dragoset, W.H.; Felder, R.D.; Hoftiezer, J.H.; Hogstrom, K.R.; Hudomalj-Gabitzsch, J.; Lesikar, J.D.; Madigan, W.P. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). *Phys. Lett., B;* **73**: No. 2, 235-238(13 Feb 1978).

The pp total cross section difference between pure transverse spin states was measured in the laboratory momentum range 1-3 GeV/c. Significant differences were found and these differences show striking energy dependence. This structure is in disagreement with the predictions of simple exchange models.

51394 Polarization in elastic scattering of 1-GeV protons by the nuclei ^{40}Ca and ^{208}Pb and the parameters of the spin-orbit amplitude. Alkhazov, G.D.; Belostotskii, S.L.; Volkov, S.S.; Vorob'ev, A.A.; Domchenkov, O.A.; Dotsenko, Y.V.; Kormin, E.G.; Kurpopatkin, N.P.; Nikulin, V.N.; Shuvaev, M.A. (B. P. Konstantinov Nuclear Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 10, 550-552(20 Nov 1977).

The polarization was measured in elastic scattering of 1-GeV protons by the nuclei ^{40}Ca and ^{208}Pb in the angle range θ/sub cms/ =1.8—13 deg. The spin-orbit amplitude parameters averaged over the protons and neutrons are obtained with the aid of Glauber's theory.

51395 Elastic interaction of elementary particles with emulsion nuclei at energies of 1 x 10^{10}—2.5 x 10^{13}/eV nucleon. Alekseeva, K.I. (Institute of Nuclear Physics, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 186-192(Aug 1977).

We compare data from our Institute on the angular distributions and anisotropy coefficients σ/sup theta//sub A/ in particle showers from interactions of 60 GeV π^- mesons and 67 and 200 GeV protons in nuclear emulsion, and also in particle jets with high multiplicity produced by cosmic-ray nucleons and nuclei with 2< or =Z< or =8 which are fragmented completely into nucleons upon collision. The experimental data indicate that in the energy range 1 x 10^{10}—2.5 x 10^{13} eV/nucleon there is a single dominant mechanism of multiple particle production for all types of inelastic interactions (interactions of different types of elementary particles, interactions of elementary particles and nuclei with nuclei). The energy released in the collision volume plays the main role in this mechanism.

STRONG MESON-INDUCED INTERACTIONS

51396 Three-pion production on complex nuclei at 23 GeV/c. Roberts, T.J.; Kruse, U.E.; Edelstein, R.E.; Makuchowski, E.J.; Meltzer, C.M.; Miller, E.L.; Russ, J.S.; Gobbi, B.; Rosen, J.L.; Scott, H.A.; Shapiro, S.L.; Strawczynski, L. (University of Illinois at Urbana-Champaign, Illinois 61801). *Phys. Rev., D;* **18**: No. 1, 59-75(1 Jul 1978).

The production of three pions has been examined in interactions of 23-GeV/c π^- with complex nuclei. A partial-wave analysis of the three-pion system has been performed showing that the spin-parity structure is very similar to the one produced in hydrogen. The production cross section for various nuclei have been compared with an optical-model calculation. In the A_1 region the absorption cross sections obtained from the model are 25 mb for J/sup P/ = 1^+ and 60 mb for J/sup P/ = 0^-.

51397 Two-particle correlations involving neutral strange particles. Harris, R.; Bogert, D.; Hanft, R.; Huson, F.R.; Kahn, S.; Smart, W.; Biswas, N.N.; Bishop, J.M.; Cason, N.M.; Kenney, V.P.; Shephard, W.D.; Albright, J.R.; Hagopian, S.; Hays, P.; Lannutti, J.E. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 1, 92-94(1 Jul 1978).

Two-particle correlation functions R (Δy) have been studied for $\pi^+\pi^-$, K°/sub S/K°/sub S/, K°/sub S/π^{+-}, $\Lambda\pi^{+-}$, and Lambda-barπ^{+-} pairs in π^-p interactions at 250 GeV/c. Dynamical correlations are estimated by subtracting a Monte Carlo calculation containing only energy and momentum conservation correlations. K°/sub S/K°/sub S/ correlations is found to be considerably larger than $\pi^+\pi^-$ correlation while K°/sub S/π^{+-}, Lambda-barπ^{+-}, and $\Lambda\pi^{+-}$ correlations are small.

51398 Energy-dependent phase shift analysis of pion-nucleon scattering below 400 MeV. Rowe, G.; Salomon, M.; Landau, R.H. (Department of Physics, University of British Columbia, Vancouver, British Columbia V6T 1W5 Canada). *Phys. Rev., C;* **18**: No. 1, 584-589(Jul 1978).

An analytic function of energy is fit to the available S, P, and D wave πN phase shifts of various goups below 400 MeV. This global average, which reproduces well most of the experiment cross sections, is anticipated to be useful in pion-nucleus and pion-nucleon interaction calculations.

51399 Investigation of the $\pi^-p\to\pi^0n$ reaction at large momentum transfers. Apel, W.D.; Augenstein, K.H.; Bertolucci, E.; Vincelli, M.L.; Donskov, S.V.; Inyakin, A.V.; Kachanov, V.A.; Quaglia, M.; Krasnokutskii, R.N.; Krueger, M.; Leder, G.; Mannelli, I.; Mikhailov, Y.V.; Prokoshkin, Y.D.; Pierazzini, G.M.; Sergiampietri, F.; Sigurdsson, G.; Scribano, A.; Toropin, A.N.; Schneider, H.; Shuvalov, R.S. *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 9, 502-505(5 Nov 1977).

Data are presented on the charge-exchange π^-p scattering at a momentum 40 GeV/c at large momentum transfers. The experiment was performed with the 70-GeV Serpukhov accelerator using a 648-channel hodoscopic γ spectrometer. The total statistics amounted to more than a million π^0 mesons, making it possible to advance into the momentum-transfer region up to -t=1.8 $(GeV/c)^2$. The experimental data are compared with the optical model of the impact parameter. The imaginary part of the trajectory of the $b_0(s)$ pole is determined from the slopes of the maxima of the function $\sqrt{-t}\,d\sigma/dt$. A linear increase of $Imb_0(s)$ with log s is observed.

51400 Investigation of the dependence of the associative multiplicity on the transverse momentum in π^-p interactions at 40 GeV/c. Abesalashvili, L.N.; Amaglobeli, N.S.; Kutsidi, N.K.; Makharadze, T.G.; Salukvadze, R.G.; Sisakyan, A.N.; Slepchenko, L.A.; Tevzadze, Y.V.; Fadeev, N.G.; Tsivtsivadze, E.T.; Chargeishvili, M.S.; Shklovskaya, A.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 172-176(Aug 1977).

We investigate the behavior of the associative multiplicity as a function of the transverse momentum of the trigger pion in various regions of phase space. The experimental results are interpreted on the basis of a model of two mechanisms that takes into account the interaction of the hadron components.

51401 Charge distribution in π^-p and π^-n semi-inclusive interactions at 40 GeV/c. Kladnitskaya, E.N.; Shekhter, V.M.; Shcheglova, L.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 176-180(Aug 1977).

Distributions of the charge of colliding particles as functions of c.m.s. rapidity are investigated for π^-p and π^-n semi-inclusive interactions. It is shown that the fragmentation regions of the π^- meson and proton charges are quite broad and overlap the central region for all n/sub plus-or-minus/ at 40 GeV/c. The charge transfers of the proton into the forward hemisphere and of the π^- meson into the backward hemisphere are determined for different n/sub plus-or-minus/. The charge fraction carried away by leading particles is given. Distributions are also given of the mean charge per particle from proton and π^- fragmentation in π^-p and π^-n interactions with n/sub plus-or-minus/< or =4 and n/sub plus-or-minus/ >4.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

51402 (ORO—5490-4) **Charmonium, the $^1P_1$ state.** Chan, L.H.; O'Connell, R.F. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). Jan 1978. Contract EG-77-S-05-5490. 13p. Dep. NTIS, PC A02/MF A01.

Based on a model which gives agreement with the observed hyperfine and fine splitting of the charmonium states, the mass of $^1P_1$ is predicted to be 3372 MeV, substantially lower than any previous predicted values. Also branching ratios and decay rates for the production of this state via channels which become accessible because of its low mass were estimated.

51403 Effects of confinement on analyticity in two-dimensional quantum chromodynamics. Brower, R.C.; Spence, W.L.; Weis, J.H. (Division of Natural Sciences, University of California, Santa Cruz, California 95064). *Phys. Rev., D;* **18**: No. 2, 499-512(15 Jul 1978).

We study the analytic properties of scattering amplitudes in two-dimensional quantum chromodynamics. The long-range confining force leads to nonanalytic behavior for individual Feynman diagrams and amplitudes involving colored external states calculated in the light-cone gauge. Nevertheless physical amplitudes involving only color-singlet external states have the normal analyticity properties. We explicitly demonstrate analyticity for the meson inelastic form factor and the elastic scattering amplitude.

ELECTROMAGNETIC INTERACTIONS

51404 (COO—1545-226) **Jet structure in e^+e^- meson production.** Kitazoe, T.; Hama, S. (Ohio State Univ., Columbus (USA). Dept. of Physics; Kobe Univ. (Japan). Dept. of Physics). 1977. Contract EY-76-C-02-1545. 35p. Dep. NTIS, PC A03/MF A01.

The matrix elements of the reaction $e^+e^- \rightarrow n\pi$ are expressed in terms of overlap integral of outcoming meson Bethe-Salpeter (B-S) amplitude. Since the B-S amplitudes of high energy mesons receive a strong Lorentz contraction, the overlap integral imposes a restriction on the outcoming momenta and predicts that the meson momenta must be separated into two narrow jets. A maximum of the overlap integral predicts a special type of distribution for meson momenta and charges in a jet, which can be tested by experiment. As the strong ordering low derived there gives no interference between the final meson states, the meson production cross sections are interpreted as quark and antiquark production by a virtual γ and their subsequent cascade decays. It is shown that the quark in this interpretation is purely light-like and has nothing to do with real quark mass. An inclusion of a vector meson in a jet gives a correct angular dependence of the jet axis and incorporates the spin $1/2$ nature of the light-like quark. A scaling low is also predicted for the momentum distributions of mesons emitted by the light-like quark.

51405 **Quantum-chromodynamic estimates for heavy-particle production.** Babcock, J.; Sivers, D.; Wolfram, S. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **18**: No. 1, 162-181(1 Jul 1978).

The associated production of hadrons containing heavy quarks is studied in the framework of a model based on quark-gluon color gauge field theory [quantum chromodynamics (QCD)]. We assume that the dominant mechanism for the production of heavy quarks in real and virtual photon beams is $\gamma (Q^2) V \rightarrow$ cc-bar where V denotes a vector gluon and c anarbitrary heavy quark. For π, p, and p-bar beams we consider the mechanisms $VV \rightarrow$ cc-bar and qq-bar $\rightarrow$ cc-bar. The cross sections for the internal subprocesses are calculated at lowest order in the perturbation expansion for QCD. We include a brief discussion of higher-order corrections to our calculation.

51406 **Schwinger's phenomenological and dyon descriptions for the new particles.** Dobson, P.N. Jr.; Tuan, S.F. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). *Phys. Rev., D;* **18**: No. 1, 296-302(1 Jul 1978).

A phenomenological description proposed by Schwinger to avoid $\Delta Y = 1$ neutral currents predicted particles much akin to the J/psi variety prior to their experimental recognition. When supplemented with a hypothetical magnetic-dyon model of matter, a natural setting is provided for the newly discovered psi particles. We extend Schwinger's earlier suggestions to cover more recently discovered states (D,D*,F,F*,Y) and their baryon analogs, using the magnetic-U-spin approach. A key test which differentiates the present description from charm theory is the existence of a relatively narrow I = 1, J/sup P/C = 1^{--} psi'' nearly mass degenerate with the established psi' (3.684). Could it be the recently discovered state psi'' (3.772)

51407 **Arguments concerning an SU(3) -scalar term in the electromagnetic current operator and the value for Γ (rho $\rightarrow \pi\gamma$).** Bohm, A.; Teese, R.B. (Center for Particle Theory, University of Texas at Austin, Austin, Texas 78712). *Phys. Rev., D;* **18**: No. 1, 330-333(1 Jul 1978).

It is shown that arguments given by Edwards and Kamal, against the explanation of the experimental value Γ (rho $\rightarrow \pi\gamma$) = 35 +- 10 keV by an SU(3) -scalar term in the electromagnetic current operator, are wrong. Sensitive experimental criteria for such an SU(3) -scalar term are listed and it is shown that the very recently obtained experimental value of the branching ratio (eta' $\rightarrow$ rhoγ)/(eta' $\rightarrow \omega\gamma$) = 9.9 +- 2 disfavors the existence of an SU(3) -scalar term large enough to explain the experimental value of Γ (rho $\rightarrow \pi\gamma$).

51408 **Test for the existence of effectively stable neutral heavy leptons.** Shrock, R.E. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). *Phys. Rev. Lett.;* **40**: No. 26, 1688-1691(26 Jun 1978).

I propose a test for the existence of stable or unusually long-lived neutral heavy leptons using a beam-dump experiment with precise timing. The technique can also be used to measure the lepton mass. Several reactions which can be help to determine the couplings of such a lepton and can serve as new probes of hadronic structure are discussed.

51409 **Covariant parametrization of nondiagonal matrix elements of the electromagnetic current by means of multipole form factors. Bosons.** Altukhov, A.M.; Krylov, A.R. (Yaroslavl' State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 197-201(Aug 1977).

In order to estimate the cross section for electron-positron annihilation into a pair of boson resonances the authors propose to use "physical" form factors analogous to the Sachs form factors for nucleons. For the general case of different bosons with arbitrary spins a parametrization of the electromagnetic vertex is obtained by means of these form factors.

51410 **Hadron production and polarization effects in two-photon e^+e^- annihilation processes.** Hennig, D.; Shakhnazaryan, Y.G. (Erevan State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 201-205(Aug 1977).

The lepton tensor corresponding to two-photon annihilation of an e^+e^- pair is calculated for the most general case in which the leptons have arbitrary polarization and the photons may be virtual. This tensor is used to construct the exact cross section for the process $e^+e^- \rightarrow 2\gamma$, to determine the cross section for the reaction $e^+e^- \rightarrow \gamma X$ involving the emission of a hard photon by the initial particles, and to study the two-photon mechanism of producing two jets of hadrons. The dependence on the polarizations of the initial particles is studied in detail in all cases.

WEAK INTERACTIONS

51411 **Comparison of trimuon production mechanisms.** Albright, C.H.; Smith, J.; Vermaseren, J.A.M. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 1, 108-122(1 Jul 1978).

We compare the predictions of six models for neutrino (and antineutrino) production of trimuon events. In particular, results are given for models based on heavy-charged-lepton decays, heavy-neutral- lepton decays together with heavy-quark decays, diffractive production and decay of heavy-quark pairs, heavy-quark cascade decays, the decays of Higgs mesons, and the radiative production of muon pairs. Our comparison should help to unravel the sources of the trimuon events detected at Fermilab and CERN. We also examine the probability of explaining the so-called superevents in which the muons are extremely energetic.

51412 **Low-energy manifestations of heavy particles: Application to the neutral current.** Collins, J.; Wilczek, F.; Zee, A. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). *Phys. Rev., D;* **18**: No. 1, 242-247(1 Jul 1978).

It is argued that in broken-symmetry theories the decoupling of heavy particles is incomplete. Some possible manifestations of this effect in neutral-current processes and the decay K/sub L/ $\rightarrow \mu\mu$ are discussed. In the case of the neutral current, heavy-particle effects may be calculated accurately including strong-interaction corrections. A new method of making such calculations is explained and its application to the neutral-current process discussed in detail. The method is more efficient than previous ones and is especially useful in calculations involving several mass scales.

51413 **Inverse scattering problem for quarkonium systems. II. Applications to psi and Y families.** Thacker, H.B.; Quigg, C.; Rosner, J.L. (Fermi National Accelerator Laboratory Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 1, 287-295(1 Jul 1978).

The inverse scattering formalism for reflectionless potentials is extended to the reconstruction of central potentials in three space dimensions. An approximate interquark potential is derived from the psi (3.095) and psi' (3.684) levels and leptonic decay widths. Remaining ambiguities are discussed in detail. Consequences for the Y family and prospects for refining the interquark potential are explored.

51414 **Is the Fermi theory of weak interactions a Yang-Mills theory in disguise.** Cooper, F.; Guralnik, G.; Snyderman, N. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **40**: No. 25, 1620-1623(19 Jun 1978).

We outline the proof of a consistent renormalization scheme for the Fermi theory (psi-barγ/sub μ/1/2taupsi)^2 in the context of a mean-field expansion in the collective excitation A/sub i//sup tsmu/ equivalent psi-barγ/sub μ/1/2tau/sub i/'psi. Ward's identities show that there is only one mass and coupling and that the induced vertices are identical to those of Yang-Mills theory with elementary gauge fields at low energy. The Green's-functions equations are displayed and used to derive an eigenvalue restriction on the coupling.

51415 **Weak hadronic currents in models with four and six quarks.** Babaev, Z.R.; Zamiralov, V.S. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 205-209(Aug 1977).

An analysis is made of the group properties of the weak hadronic currents constructed from the quarks in the SU (n) schemes for n between 3 and 6. It is shown that the absence of neutral currents which change the internal quantum numbers (strangeness, charm, etc.) can be ensured in the framework of unitary symmetry with an even number of quarks by an appropriate choice of the

initial weak current in a given multiplet. The proposed method of constructing the weak hadronic currents in the unitary symmetry schemes provides a completely natural way of determining the general form of the current with the correct right-handed and left-handed components. The method can readily be generalized to the case of arbitrary n. The physical consequences for the SU (6) quark scheme are briefly discussed.

51416 Microcausality, equal-time current commutators, and sum rules in ep and νp scattering. Geshkenbein, B.V. (Institute of Theoretical and Experimental Physics, State Committee for the Use of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 218-223(Aug 1977).

The microcausality condition, used as an equation, makes it possible to express the functions W/sub i/(ν,q^2) for $q^2>0$ in terms of the same functions for $q^2<0$, where W/sub i/(ν,q^2) for $q^2<0$ are functions describing inelastic ep and νp scattering. This makes it possible to express all equal-time current commutators in terms of the functions W/sub i/(ν,q^2) for $q^2<0$ and to obtain known sum rules, as well as some new ones. In particular we show that the Adler sum rule can only be valid for vertical-barq^{2}vertical-bar→∞. A previously obtained spectral representation for the functions W/sub i/(ν,q^2) [B. V. Geshkenbein and A. I. Komech, Yad Fiz. 26, No. 2, 446 (1977)] is used in the derivation of the sum rules.

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 51405, 51431

51417 Spectrum of quantum chromodynamics in the limit of an infinite number of colors at fixed coupling. Brower, R.; Giles, R.; Thorn, C. (Department of Physics, University of California, Santa Cruz, California 95064). *Phys. Rev., D;* **18**: No. 2, 484-498(15 Jul 1978).

We study quantum chromodynamics in the limit of an infinite number of colors, N/sub c/, at fixed coupling, g/sub s/. On a null-plane lattice, the field theory can be recast as an interacting string model. The resulting dual string has internal degrees of freedom corresponding to the spin of the gluon quanta. The dynamics of these spins is that of an isotropic Heisenberg antiferromagnet. In the limit N/sub c/ → ∞, low orders in the dual loop expansion are expected to give a good approximation to the spectrum (modulo effects such as spontaneous symmetry breakdown). We find that, in this limit, all particles lie on linear Regge trajectories. Quarkless gluonic states correspond to closed strings, and the spectrum is Lorentz invariant if the intercept of the leading trajectory is two. Open strings are terminated by a quark and an antiquark, and the rho trajectory must have intercept unity. Our limit preserves chiral symmetry: There is a J/sup P/C = 0/sup (/+ scalar degenerate with the "pion" 0^{-+}. Both these particles are tachyons, so chiral symmetry may be spontaneously broken by string interactions. Our N/sub c/ → ∞ calculations are similar to zero-temperature expansions in statistical mechanics. We expect them to give a qualitatively correct description of the ordered phase (confined quarks). We suggest that there is a critical number of colors below which confinement is lost. If N/sub c/ = 3 is close to this critical value (hopefully above it), the 1/N/sub c/ expansion might not give quantitatively accurate results.

51418 (SLAC-Trans—183) **Inelastic processes in quantum cyromodynamics.** Dokshitser, Yu.L.; D'Yakonov, D.I.; Troyan, S.I. 1978. Translated from pp 1-89 of Fizika elementarnykh chastits XIII Zimnei Shkoly LIYaF of the Leningrad B.P. Konstantinov Institute of Nuclear Physics, Leningrad, 1978. 60p. Dep. NTIS, PC A04/MF A01.

Several objectives are pursued. On the one hand, the rise and subject of a new science--quantum chromodynamics (QCD)--which currently lays claim to the role of a theory of the strong interactions is discussed. On the other hand, it analyzes in detail, from the standpoint of chromodynamics, the physics of so-called inelastic processes involving hadrons, in which distances small in comparison with the dimensions of hadrons play a significant part. Inelastic processes include the deep inelastic scattering of leptons on hadrons, e^+e^- annihilation to hadrons, the production of massive lepton pairs in hadron collisions and others. Finally, a number of new findings are contained concerning the predictions of QCD for inelastic processes. They all are related in one way or another to the characteristic increase in the transverse momenta of hadrons in these processes.

STRONG INTERACTIONS, BARYON NO.=0

51419 Observation of a new regularity in hadronic spectra. Raja, R. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 1, 204-209(1 Jul 1978).

We present evidence using 100-GeV/c pp-bar interactions and pp interactions at 102, 205, 303, and 405 GeV/c for the hypothesis that the ratio of an inclusive cross section ab → c-bar + X to ab → c-bar + X/sub s/, where X/sub s/ is a subset of X, is a function of M^2, the effective mass squared of X (and X/sub s/) only and not of s and t. A summary of the rationale leading up to the hypothesis is also given. The hypothesis is seen to be obeyed in all areas of phase space in the reactions considered.

51420 Heavy vector mesons associated with Υ (9.4) and the nature of Υ' (10). Young, B.; Kuroda, M. (Ames Laboratory-USDOE and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., D;* **18**: No. 1, 344-346(1 Jul 1978).

Extending a previously proposed scheme for the meson leading Regge trajectories we discuss the possible new heavy vector and pseudoscalar mesons carrying the quantum numbers hidden in Υ (9.4). We calculate the range of values of their masses and argue that the Υ' (10) is probably not the first radial excitation of Υ (9.4). A linear mass formula is proposed to relate the masses of all the vector mesons including the new heavy ones.

STRONG INTERACTIONS, BARYON NO.=1

51421 Partial-wave analysis of the K-barN system from 360 to 1320 MeV/c. Alston-Garnjost, M.; Kenney, R.W.; Pollard, D.L.; Ross, R.R.; Tripp, R.D.; Nicholson, H.; Ferro-Luzzi, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., D;* **18**: No. 1, 182-197(1 Jul 1978).

In this paper we use new data from several recent K-barN experiments in conjunction with older data to make an energy-dependent partial-wave analysis of the K-barN system. The important new additions never used before in a partial-wave analysis are our precision measurements of the charge-exchange total cross sections, our measurements of the charge-exchange angular distributions, and the first measurements of the K^-p polarization at these low momenta. A new feature introduced in the analysis is the S-wave cusp treatment at the λeta and Σ^0eta thresholds, which we find necessary to describe the observed behavior in the charge-exchange total cross sections near these thresholds. Other features include a single-channel unitary formulation for resonances and backgrounds and a parametrization of these amplitudes incorporating centrifugal-barrier effects. New values for masses, widths, and elasticities for resonances in this region are reported and better evidence is found for several of the less well established resonances. None of the new resonances suggested by recent I = 0 and I = 1 total-cross-section measurements are required. Fits are displayed for all the data used and predictions of this partial-wave analysis are compared with those of two other recent analyses for certain quantities yet to be measured. A table of the amplitudes, in steps of 20 MeV/c, is provided.

51422 Sum rule for kaon-nucleon scattering. Finkelstein, J. (Columbia University, New York, New York 10027). *Phys. Rev., D;* **18**: No. 1, 336-337(1 Jul 1978).

It is observed that the measured cross sections for the reactions $K^-p \to$ K-bar^{0}n and $K^-p \to$ K-bar$^0\Delta^0$ at p/sub lab/ = 13GeV/c are in agreement with the prediction (dσ/dt)/sub k/-p → k-bar0n = 2(dσ/dt)/sub K/-p → K-bar0Δ0.

51423 Average transverse distance between partons as measured by nucleon form factors. Gunion, J.F. (California Univ., Davis (USA). Dept. of Physics); Soper, D.E. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). *Phys. Lett., B;* **73**: No. 2, 189-192(13 Feb 1978).

The values of $dF_1(q^2)/dq^2$ at $q^2=0$ for the neutron and the proton provide a measure of the average transverse separations squared, $\langle y^2\rangle$, between a u or d quark and the rest of the partons in a nucleon. By using the measured values of the form factors (together with parton x-distributions), it is found that $\langle y^2\rangle = 17.4$ GeV^{-2} for u quarks and 16.4 GeV^{-2} for d quarks in a proton. It is speculated that the small difference between u and d quarks is caused by 'quark pairing', and othe possible experimental signatures of quark pairing are discussed.

51424 Inclusive reactions on a polarized target in the beam fragmentation region. Zamolodchikov, A.B.; Kopeliovich, B.Z.; Lapidus, L.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 209-213(Aug 1977).

A study is made of the scattering asymmetry in inclusive processes in the beam fragmentation region. A general expression is obtained for the cut contribution to the asymmetry of the reaction cross section in the triple-Reggeon region. The asymmetry is calculated numerically for the reactions $\pi^{+-}p \to \pi^0X$ and $\pi^{+-}p \to \pi^{+-}X$. It is shown on the basis of the quark model that the asymmetry in inclusive processes in the region of small masses M^2 is similar to the asymmetry in elastic scattering and that its value falls off with increasing mass. An estimate is given of spin correlations in the reaction pp→pX.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

51425 (LBL—7724) **Small, large, and very large transverse momenta in a unified hydrodynamical description.** Friedlander, E.M.; Weiner, R.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1978. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

Thesis.

Two apparently unrelated effects, viz. the behavior of transverse momentum spectra at "large" p/sub T/ in p-p collisions and the "enhancement" of such spectra in p-nucleus collisions, are shown to follow in a natural way from a hydrodynamical model in which the space-time evolution of the system is taken into account. Up to p/sub T/ congruent to 5 GeV/c a single value (close to u^2 congruent to $1/7$) for the velocity of sound in hadronic matter gives a consistent description of all experimental facts. Recent observations at very large p/sub T/ (5 to 15 GeV/c) require a jump to u^2 approximately $1/4$, suggesting the possibility of a phase transition of the second kind.

51426 **Elastic backward pd scattering in the resonance region.** Kondratyuk, L.A.; Lev, F.M. (Institute of Theoretical and Experimental Physics, State Atomic Energy Commission). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 153-157(Aug 1977).

We analyze the contribution of the mechanism of double scattering with intermediate Δ-isobar production to the amplitude of elastic backward pd scattering. It is shown that allowance for this mechanism in conjunction with the pole mechanism and the interference contribution leads to a satisfactory description of the energy and angular dependences of the backward pd-scattering cross section in the energy region E/sup kin//sub lab/=0.4 to 1 GeV. An increase of the slope of the angular dependence of the differential cross section is predicted as the scattering angle approaches 180°.

51427 **Study of the NN-amplitude in experiments on the scattering of nucleons by nuclei at high energies.** Manaenkov, S.I. (Tula Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 158-162(Aug 1977).

It is shown that the data on the angular distribution of the γ-ray intensity of natural-parity levels do not account fully for the amplitude of elastic NN scattering. The missing information can be obtained either by measuring the circular polarization of the γ radiation of these levels, or by studying the angular correlation between the momentum of the scattered particle and the momentum of the photon produced in the decay of the 1^+ state. In either case the levels should be excited by polarized nucleons, but in the second case the use of a longitudinally polarized beam is not mandatory.

51428 **Multiplicities of secondary particles of various types in high-energy proton-nucleus inelastic collisions.** Azimov, S.A.; Bondarenko, A.I.; Gulamov, K.G.; Ruzimatov, R.V.; Skripnik, N.S.; Chernov, G.M. (Physico-technical Institute, Academy of Sciences of the Uzbek SSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 180-185(Aug 1977).

The distributions of proton-nucleus collisions in the energy range from 20 to 200 GeV with respect to the multiplicities of secondary particles of various types have been examined and their principal characteristics (shapes, means, p_0 and A dependences, scaling properties, and correlations) are discussed. It is shown that the particle-production mechanisms effective in collisions with nuclei and with nucleons are much the same, although a probable contribution from low-energy cascading can be detected in the former.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

51429 **Spectrum-generating SU(4) in particle physics: SU(n) and particle assignments.** Bohm, A.; Hossain, M.; Teese, R.B. (Center for Particle Theory, Department of Physics, University of Texas, Austin, Texas 78712). *Phys. Rev., D;* **18**: No. 1, 248-257(1 Jul 1978).

The conventions and representations of SU(n) as used in the spectrum-generating-group approach to particle physics are described. The particle assignments are given in terms of Gelfand-Zetlin basis vectors, and the most useful Clebsch-Gordan coefficients are listed. The electric charge operator and the electromagnetic current operator are defined and the matrix elements of the electromagnetic current operator are discussed.

APPLICATIONS TO STRONG INTERACTIONS

51430 **Uniqueness of the SU/sub N/ gauge groups for implementing absolute proton stability with a global U_1 of color.** Langacker, P.; Segre, G.; Weldon, H.A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., D;* **18**: No. 2, 552-560(15 Jul 1978).

The problem of ensuring proton stability in grand unified models of the strong, weak, and electromagnetic interactions by means of a new conserved quantum number is investigated. It is assumed that spontaneous symmetry breaking will preserve an SU/sup c/$_3$ of color. To guarantee that the new quantum number chi be conserved after the spontaneous symmetry breaking, we require that all color-singlet Higgs fields in the theory have chi = 0. This assumption has the following consequences: The gauge symmetry must be SU/sub N/, the global symmetry must be U/sub N/, chi must generate the U/sup c/$_1$ of color, and only certain representations for the Higgs scalars are possible. Conservation of chi also restricts the possible SU/sub N/ fermion assignments. In particular, if all fermions are either singlets, triplets, or antitriplets of color and if the only massless fermions are chi = 0 neutrinos, then conservation of chi requires that either the model is vectorlike or that there are many fermion representations, some of which include families of particles with unusual values of chi. Both cases are anomaly free.

FIELD THEORY

REFER ALSO TO CITATION(S) 51418

51431 (ORO—5490-5) **Interrelations between symmetry breaking and dynamics in strong interactions. Progress report, July 1, 1977—June 30, 1978.** Chan, L.H.; Haymaker, R. (Louisiana State Univ., Baton Rouge (USA)). 1978. Contract EG-77-S-05-5490. 14p. Dep. NTIS, PC A02/MF A01.

A study of renormalization of a model field theory with a four-fermion interaction is reported. Starting from the super-renormalizable lagrangian L = anti psi(iγdelta/ - gsigma)psi - $\mu^2/2$sigma^2 + $1/2$(delta/sub μ/sigma)^2 + lambda/4 sigma^4 in (1 + 1) dimensions it is demonstrated that in the mean field approximation it goes over to the renormalizable Gross-Neveu model as the wave function renormalization constant of the sigma goes to zero. The important result is that no new counter terms are required in this limit to render the model finite, beyond the deltaμ^2 to make the sigma model finite. This is carried through in detail through second order (the first nontrivial order). Also formal arguments are given that it is true to all orders. The complete results of vector meson dominance is derived from the dominating single quark-loop contribution in the SU(3) sigma model. The symmetry breaking effects were investigated in the spin-spin interaction arising from strong interaction gluon exchange due to different quark masses. Recent SLAC measurements confirmed the prediction on D^+-D^0 and D/sup *+/ - D/sup *0/. Many interesting aspects were found in the MIT bag model in connection with the analysis. We suggested that the (hyper)fine splittings of the charmonium can be resolved by a dominating contribution of a scalar exchange potential and the mass of the $^1P_1$ states is predicted to be 3372 MeV.

51432 **Path-integral representation for the S-matrix.** Hammer, C.L.; Shrauner, J.E.; De Facio, B. (Ames Laboratory: USDOE, Iowa State University, Ames, Iowa 50011). *Phys. Rev., D;* **18**: No. 2, 373-384(15 Jul 1978).

We present a formulation of quantum field theory as a path-integral representation for elements of the U or S matrix in the coherent- state basis. These matrix elements are shown to serve as generating functionals for all the usual S-matrix elements between statesof definite particle number. The coherent-state formalism for general bilinear quantum field theories is described and then incorporated into the construction of a path integral such that the formulation is independent of any canonical formalism. We discuss the relationship of this formulation to the usual path-integral formulation and show in what sense they are equivalent for canonical theories. We also discuss how this formulation is more general than the usual one in that it is well defined even for theories having no canonical form and for which a Lagrangian action and the usual path-integral formulation may not apply. Applications of this formulation to specific calculations are exhibited for the cases of a quantized field interacting with a given external source and for the renormalization of the simple quantum field theory model of a scalar meson field interacting with a nonrelativistic nucleon field.

51433 **Theory of static quark forces.** Adler, S.L. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Phys. Rev., D;* **18**: No. 2, 411-434(15 Jul 1978).

Working within the framework of classical algebraic chromodynamics, I develop a theory of the equilibrium color forces acting between stationary quarks. To identify the equations appropriate to

describing static forces on a fixed time slice, I assume that the "static" color fields appear as the end point of a most probable tunneling process and satisfy the principle of virtual work. The static equations imply certain compatibility conditions on the orientations of discrete quark charges relative to the local color field. The static equations for chromodynamics take a simple form only at the instant of tunneling. Static forces and potentials calculated on this favored time slice describe the behavior of the system at all later times because of gluon energy conservation. When the static equations of algebraic chromodynamics for the qq-bar color-singlet force problem are rewritten as equations for the overlying SU(2) classical Yang-Mills field, they take the form of the equations of the 't Hooft-Polyakov model, but with the Higgs field reinterpreted as the static potential and, of course, with external source charges present. I develop these equations in a perturbation expansion in the color gluon coupling g. I conjecture that the relevant zeroth-order solution is the unit-topological-charge solution of 't Hooft and Polyakov, which appears to behave as a quark-confining "bag." This solution contributes a zeroth-order orientation energy to the quark potential, which by the principle of virtual work must be extremal with respect to variations in the position and orientation of the "bag." The orientation energy gives the qq-bar potential a repulsive central core, and also leads to a zeroth-order σ/sup m//sub(n)/Q/sup eff//sub(n)/ x B/sup m/ interaction between the quark spins and the "bag" color magnetic field. The compatibility conditions guarantee that the orientation energy is invariant under changes of gauge of the zeroth-order solution

51434 Force between two point charges in a two-dimensional bag. Giles, R. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **18**: No. 2, 513-519(15 Jul 1978).

The problem of two opposite static electric charges confined in a MIT bag in two space dimensions is solved. The bag shape, electrostatic potential, and total energy are determined for arbitrary charge separation. The bag surface is smooth except for two cusps located along the line joining the charges. For large charge separations, the bag is cigar shaped and the total energy becomes linear in charge separation. The onset of this linear effective potential is seen to occur well before the limiting cigar shape is achieved.

51435 Phase transition in the nonlinear SU(n) lattice field theory. Baaquie, B.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **18**: No. 2, 567-573(15 Jul 1978).

We solve for the phase diagram (phase transition) of the nearest-neighbor-coupling SU(n) nonlinear scalar action. We do a one-loop calculation for the effective coupling constant, and find that the system undergoes a phase transition for dimension $d > 2$. For $d = 2$, the theory is asymptotically free.

51436 Vacuum polarization by a source-free gauge field. Batalin, I.A.; Matinyan, S.G.; Savvidi, G.K. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 214-217(Aug 1977).

One-loop corrections due to vacuum polarization are studied for a Yang-Mills theory. The discussion is carried out in covariant gauges. In the special case of covariant-constant fields the one-loop correction to the effective action has been calculated by analogy to the Heisenberg-Euler correction in QED. It is shown that in the limit of a strong "magnetic" Yang-Mills field the vacuum polarization decreases logarithmically. This effect is a direct manifestation of the asymptotic freedom of the theory. In the case of the "electric" field there occurs a strong instability of the vacuum state.

51437 Spectral representations for inelastic form factors of nucleons. Geshkenbein, B.V.; Komech, A.I. (Institute of Theoretical and Experimental Physics, State Atomic Energy Commission). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 235-236(Aug 1977).

A represention is proposed for the nucleon inelastic form factors in place of the customarily used Deser, Gilbert, and Sudarshan Form. This representation is based on microcausality and spectrality requirements alone. (AIP)

SCATTERING THEORY

51438 General algebraic theory of identical particle scattering. Bencze, G.; Redish, E.F. (Central Research Institute for Physics, H-1525 Budapest 114, P.O.B. 49, Hungary). *J. Math. Phys. (N.Y.);* **19**: No. 9, 1909-1917(Sep 1978).

We consider the nonrelativistic N-body scattering problem for a system of particles in which some subsets of the particles are identical. We demonstrate how the particle identity can be included in a general class of linear integral equations for scattering operators or components of scattering operators. The Yakubovskii, Yakubovskii—Narodestkii, Rosenberg, and Bencze—Redish—Sloan equations are included in this class. Algebraic methods are used which rely on the properties of the symmetry group of the system. Operators depending only on physically distinguishable labels are introduced and linear integral equations for them are derived. This procedure maximally reduces the number of coupled equations while retaining the connectivity properties of the original equations.

51439 Inverse scattering problem for quarkonium systems. I. One-dimensonal formalism and methodology. Thacker, H.B.; Quigg, C.; Rosner, J.L. (Fermi National Accelerator Laboratory Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 1, 274-286(1 Jul 1978).

The inverse scattering formalism for reflectionless potentials is applied to the reconstruction of confining potentials from bound-state properties. An explicit algebraic technique is presented and tested on several one-dimensional examples. The connection with a classical problem of interacting solitons is exhibited.

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

51440 (DOE/ER—0009) Research in the nuclear sciences: summaries of FY 1978. (Department of Energy, Washington, D.C. (USA). Div. of Nuclear Sciences). Jun 1978. 68p. Dep. NTIS, PC A04/MF A01.

Programs funded in fiscal year 1978 by the Division of Nuclear Sciences/Office of Basic Energy Sciences are summarized. Each summary is preceded by a heading that includes institution, title, principal investigators, budget reporting category, and operating funds provided in FY 1978. The summaries are presented in alphabetical order by institution. Indexes are appended to facilitate the location of a summary according to an investigator's name or a budget reporting category. (RWR)

51441 Content of ENDF/B and future considerations. Pearlstein, S.; Kinsey, R.; Dunford, C. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **28**: 735(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51442 ENDF/B-V content and performance in fast reactor systems. McKnight, R.D. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 735-736(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51443 Fission product and actinide data evaluations for ENDF/B-V. Schenter, R.E. (Westinghouse Hanford Co., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 738-739(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51444 ENDF/B-V special applications files (SAFE). Mann, F.M. (Westinghouse Hanford Co., Richland, WA). *Trans. Am. Nucl. Soc.;* **28**: 739-740(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 51498

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

51445 Search for neutron nuclei in absorption of π^- mesons in emulsion loaded with ^{7}Li. Batusov, Y.A.; Vizireva, L.; Kovacheva, V.B.; Cueer, P.; Massue, J.P.; Mirsalikhova, F.; Sidorov, V.M.; Chernev, K.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 129-131(Aug 1977).

A search has been carried out in nuclear emulsion loaded with ^{7}Li nuclei in the attempt to find neutron nuclei in the π^- capture reactions $\pi^- + {}^7\mathrm{Li} \rightarrow {}^4\mathrm{He} + {}^{"3}\mathrm{n}"$ and $\pi^- + {}^7\mathrm{Li} \rightarrow {}^3\mathrm{He} + {}^{"4}\mathrm{n}"$.

It is found that the upper limit of the relative probability for formation of ^{3}n and ^{4}n nuclei in such reactions at the 90% confidence level does not exceed 1.2 x 10^{-3}.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

51446 Alpha transfer to ^{18}O with empirical wave functions. Fortune, H.T.; Kurath, D. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **18**: No. 1, 236-238(Jul 1978).

Wave functions for ^{18}O derived from fits to particle-transfer and γ-decay data have been used in finite-range distorted-wave calculations of the reaction ^{14}C(^{7}Li,t)^{18}O. The agreement between experimental and theoretical cross sections is excellent.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 51464

51447 (LBL—6714) **New approximation for Glauber theory on stripping of relativistic deuterons.** Nissen-Meyer, S.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1978. Contract W-7405-ENG-48. 25p. (CONF-770873—7). Dep. NTIS, PC A02/MF A01.

From 7. international conference on high energy physics and nuclear structure; Zurich, Switzerland (30 Aug 1977).

The momentum distribution of forward protons from relativistic collisions of deuterons with nuclei is computed from a Glauber theoretical Ansatz of Bertocchi and Tekou. The outgoing proton-neutron scattering state (disintegrated deuteron) with a plane wave minus the components of this plane wave along the deuteron bound state vector is approximated. With no fitted parameters good agreement is found with data from the reaction d + C^{12} → p + X in the region corresponding to nonrelativistic Fermi momenta in the forward direction. At more relativistic Fermi momenta, the model deviates more from the data, which can be due to incorrect choice of the short distance part of the deuteron wave function as well as off-shell effects in the deuteron.

51448 Coupled-channels analysis of inelastic proton scattering from ^{12}C at 0.8 GeV. Ray, L.; Blanpied, G.S.; Coker, W.R.; Liljestrand, R.P.; Hoffmann, G.W. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **40**: No. 24, 1547-1549(12 Jun 1978).

We present an analysis of new data for 0.8-GeV inelastic proton scattering to the 2^{+} (4.4 MeV) and 4^{+} (14.1 MeV) states of ^{12}C, using both distorted-wave Born-approximation and coupled-channels calculations with empirical, spherical, and deformed optical potentials. Both the deformation of the optical potential and the two-step transition via the 2^{+} state are shown to influence strongly the shape and magnitude of the calculated 4^{+} inelastic angular distribution.

51449 Photoproduction and radiative capture of pions in nuclei in the current-algebra model with energetic pions. Radutskii, G.M.; Serdyutskii, V.A. (Institute of Nuclear Physics, Electronics, and Automation at the Tomsk Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 163-167(Aug 1977).

The amplitudes of photoproduction and radiative capture of pions are obtained for the nuclear partial transitions (0^{+}→1^{+}) within the framework of a model based on current algebra with energetic pions. If the nonpole parts are suitably chosen, the amplitudes depend on only one unknown parameter: the corresponding constant of the pion-nucleus interaction. In the case of the reaction on ^{6}Li, this constant was determined from the total cross section for photoproduction at the threshold and led to good agreement with the available data for the rate of radiative capture from the 1s and 2p shells of the mesic atoms.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

51450 Masses of the unbound nuclei ^{16}Ne, ^{15}F, and ^{12}O. KeKelis, G.J.; Zisman, M.S.; Scott, D.K.; Jahn, R.; Vieira, D.J.; Cerny, J.; Ajzenberg-Selove, F. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., C;* **17**: No. 6, 1929-1938(Jun 1978).

The (^{4}He,^{8}He) and (^{3}He,^{8}Li) reactions have been employed at detection angles near 8° on gas targets of ^{20}Ne and ^{16}O to produce and measure the masses of the nuclei ^{16}Ne, ^{15}F, and ^{12}O. The (^{4}He, ^{8}He) reactions were performed at an incident energy of 117 MeV, and the (^{3}He, ^{8}Li) reaction was done at 88 and 75 MeV. The mass excesses of ^{16}Ne, ^{15}F, and ^{12}O were determined to be 23.92 +- 0.08, 16.67 +- 0.18, and 32.10 +- 0.12 MeV, respectively. Estimated ground state decay widths were Γ/sub c.m./ = 0.2 +- 0.1, 0.8 +- 0.3, and 0.40 +- 0.25 MeV, for ^{16}Ne, ^{15}F, and ^{12}O, respectively. A d coefficient of 8 +- 5 keV is indicated for the isobaric multiplet mass equation description of the mass-16 multiplet. Consideration of the possible decay mechanisms of ^{16}Ne and ^{12}O indicates that both nuclei probably have an appreciable diproton decay width.

RADIOACTIVE DECAY

51451 Super-allowed Fermi β decay: Half-lives of ^{14}O and ^{38}K/sup m/. Wilkinson, D.H.; Gallmann, A.; Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **18**: No. 1, 401-407(Jul 1978).

The half-lives of the Fermi super-allowed β-ray transitions from ^{14}O and ^{38}K/sup m/ have been measured by multiscaling γ rays (from ^{14}O) or β rays (from ^{38}K/sup m/) detected in a plastic scintillator. The activities were made via the reactions ^{12}C(^{3}He,n)^{14}O at E/sub 3He/ = 2.9 MeV and ^{35}Cl(α,n) ^{38}K/sup m/ at E/sub b/ = 8.0 MeV respectively. Results for the half-lives were as follows: ^{14}O-70.613 +- 0.025 sec, and ^{38}K/sup m/-921.71 +- 0.65 msec. Recommendations as to the "best" half-life values for the set of eight most accurately measured Fermi super-allowed transitions are presented and comments are made on the present status of knowledge of the nucleon's mean quark charge as extracted from such transitions following acceptance of Cabibbo universality and the gauge theories as exploited by Sirlin. The value recommended for the vector coupling coefficient effective for nucleon β decay (including the "inner" radiative correction) is g/sup R//sub betaV/ = (1.41248 +- 0.00044) x 10^{-49} erg cm^{3}.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 51456

51452 Survey of the (α,^{2}He) reaction on 1p- and 2s1d-shell nuclei. Jahn, R.; Stahel, D.P.; Wozniak, G.J.; de Meijer, R.J.; Cerny, J. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., C;* **18**: No. 1, 9-22(Jul 1978).

A ^{2}He detection system has been developed and used to investigate the (α,^{2}He) reaction at bombarding energies of 55 and 65 MeV on targets of ^{12}C, ^{13}C, ^{14}N, ^{15}N, ^{16}O, ^{18}O, ^{20}Ne, ^{22}Ne, ^{24}Mg, ^{26}Mg, ^{28}Si, ^{29}Si, ^{32}S, ^{36}Ar, ^{38}Ar, and ^{40}Ca. Preferential population of two-neutron states with dominant (d/sub 5/2/)^{2}$_{4}$, (d/sub 3/2/f/sub 7/2/)$_{6}$, and (f/sub 7/2/)^{2}$_{6}$ character was observed. A linear A dependence of the binding energies of the J/sup π/ = 5^{-} and 6^{+} states was obtained. This systematic behavior is well described by the Bansal-French model, using the parameters a = - 0.30 MeV and b = 2.6 MeV. Simple shell-model calculations for the 2n configurations are in good agreement with the experimental data.

51453 Comment on a search for a $0^{-} \rightarrow 0^{+}$ pair transition in ^{16}O. Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **18**: No. 1, 576-578(Jul 1978).

The possible $0^{-} \rightarrow 0^{+}$ ground-state pair decay of the ^{16}O 10.95- MeV 0^{-} state was reinvestigated using the ^{19}F (p,α)^{16}O reaction at E/sub p/ = 5.4—5.7 MeV and a magnetic pair spectrometer. A previously reported pair peak of 3.84 MeV due to the 10.952 → 7.117-MeV transition was not observed. The data indicate a much smaller relative population of the 10.95-MeV state in this reaction than reported previously and this places doubt on the upper limit derived earlier for the $0^{-} \rightarrow 0^{+}$ ground-state pair decay. In a test of the ^{14}N(^{3}He,p)^{16}O reaction at E/sub 3He/ = 4 MeV the yield was too low to study the 10.95-MeV state. Using the ^{12}C(d,p)^{14}C reaction at E/sub d/ = 4.5 MeV the $0^{-} \rightarrow 0^{+}$ ground-state branch from the 6.90-MeV 0^{-} state of ^{14}C was found to be $<1.1 \times 10^{-4}$ via pair decay. The corresponding lifetime limit, tau ($0^{-} \rightarrow 0^{+}$)/sub e/+e-> 3 x 10^{-10} sec, is not considered significant. It is concluded that a sensitive search for M0 pair transitions remains to be made.

51454 Electroexcitation of the ground-state rotational band in ^{19}F. Williamson, C.F.; Rad, F.N.; Kowalski, S.; Heisenberg, J.; Crannell, H.; O'Brien, J.T.; Lee, H.C. (Bates Linear Accelerator Center, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev. Lett.;* **40**: No. 26, 1702-1705(26 Jun 1978).

Cross sections for the electroexcitation of the ground-state rotational band on ^{19}F have been measured over the momentum transfer range 0.5 < or = q < or = 2.5 fm^{-1} and are compared to calculation based on the variation-after-projection, Hartree-Fock approximation. The data support the predicted predominance of L x S coupling for this band. The 5464-keV level is unambiguously identified as the 7/2+ member of the ground-state band.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 51450, 51452

51455 Determination of the cross section for formation of $^{8}Be_4$ nuclei in photonuclear reactions at energy E/sub γ/=1.5—4.5 GeV. Galstyan, D.A. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 117-119(Aug 1977).

The cross section for formation of $^{8}Be_4$ nuclei in photonuclear reactions is determined. For the average emulsion nucleus and for γ rays in the interval E/sub γ/=1.5—4.5 GeV the cross section in the energy range of $^{8}Be_4$ nuclei E-bar ($^{8}Be_4$) =10—80 MeV is found to be σ/sub γ/($^{8}Be_4$) =0.36 +- 0.08 mb/Q. The ratio of the partial cross section to the total hadronic photo-cross-section remains constant in this range of γ-ray energy.

51456 (LA—7262-T) Scattering of 0.8 GeV protons from lead-208, carbon-12, and carbon-13. Blanpied, G.S. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 137p. Dep. NTIS, MF A01.

Thesis. Submitted to Univ. of Texas, Austin. Portions of document are illegible.

The first angular distributions for elastic scattering of 0.8 GeV protons from ^{12}C, ^{13}C, and ^{208}Pb, obtained using the High Resolution Spectrometer (HRS) at the Clinton P. Anderson Meson Physics Facility (LAMPF) at the Los Alamos Scientific Laboratory, are presented. A brief description is given of an analysis of the elastic scattering data in terms of the Kerman-McManus-Thaler formalism with spin dependent nucleon-nucleon amplitudes. The data are shown to be sensitive to details of proton and neutron matter distributions. The proton distributions as determined by electromagnetic probes are used along with the available spin independent nucleon-nucleon scattering amplitudes. Preliminary analyzing power measurements are used to fix the spin-dependent amplitudes. The neutron distributions are adjusted to fit the data. Inelastic scattering of protons, exciting the first two states of ^{208}Pb and many states in ^{13}C and ^{12}C, is analyzed in terms of the distorted wave Born approximation (DWBA). The model of coupling a $^{1}/_{2}^{-}$ neutron to the excited states of ^{12}C is found to explain some of the ^{13}C excited states. Using this model a new assignment of J/sup π/ = $^{7}/_{2}^{+}$ has been made to the 11.9 MeV state of ^{13}C. A coupled channels calculation using a 0^+, 2^+, 4^+ rotational band is found to explain the 4^+, 14.1-MeV state in ^{12}C.

51457 Search for structure in the fusion of ^{16}O + ^{40}Ca. Geesaman, D.F.; Davids, C.N.; Henning, W.; Kovar, D.G.; Rehm, K.E.; Schiffer, J.P.; Tabor, S.L.; Prosser, F.W. Jr. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **18**: No. 1, 284-289(Jul 1978).

The fusion of ^{16}O + ^{40}Ca has been studied in small energy steps in the energy range 45 < or = E/sub lab/ < or = 63 MeV. Fusion cross sections were measured by the detection of evaporation residues in a ΔE-E particle telescope and by measurement of prompt γ-ray activity. The fusion excitation functions show relatively smooth behavior with no evidence for oscillatory structure of the magnitude observed in the fusion of ^{16}O + ^{12}C.

51458 Absolute measurement of the $^{7}Li(n,n'\gamma)^{7}Li^*$ (0.478-MeV) cross section. Olsen, D.K.; Morgan, G.L.; McConnell, J.W. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 742-743(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51459 Measurement of the asymmetry of quasielastic scattering of polarized protons with energy 635 +- 15 MeV by ^{12}C and ^{6}Li nuclei. Nadezhdin, V.S.; Petrov, N.I.; Satarov, V.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 119-121(Aug 1977).

Measurements have been made of the left-right asymmetry of quasielastic scattering of polarized protons with energy 635 +- 15 MeV by carbon and lithium nuclei for various momenta transferred to the residual nucleus. A dependence of the measured asymmetry on the velocity of relative motion of the incident and nuclear nucleons is observed.

51460 Inelastic scattering of 60-MeV π^+ mesons from light nuclei with emission of deuterons and helium nuclei. Gismatullin, Y.R.; Lantsev, I.A.; Ostroumov, V.I. (Leningrad Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 126-129(Aug 1977).

The inelastic scattering of 60-MeV π^+ mesons from light nuclei (carbon, nitrogen, and oxygen) with emission of single deuterons or helium nuclei has been investigated in nuclear emulsions. The integrated reaction cross sections, the momentum and angular distributions of the residual nuclei, the energy and angular distributions of the deuterons and helium nuclei, and the differential cross section for the scattered pions were obtained. The experimental distributions are compared with calculations based on the dispersion theory of direct nuclear reactions. It is shown that the experimental data can be described by a pole diagram with a virtual deuteron or helium nucleus.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 51452

NUCLEAR REACTIONS AND SCATTERING

51461 (ORNL/TM—6281) Na(n,xγ) reaction cross section for incident neutron energies between 0.2 and 20.0 MeV. Larson, D.C.; Morgan, G.L. (Oak Ridge National Lab., Tenn. (USA)). May 1978. Contract W-7405-ENG-26. 71p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Differential cross sections for the neutron-induced gamma-ray production from sodium were measured for incident neutron energies between 0.2 and 20.0 MeV. The Oak Ridge Electron Linear Accelerator (ORELA) was used to provide the neutrons and a NaI spectrometer to detect the gamma rays at 125°. The data presented are the double differential cross section, d^{2}sigma/dΩdE, for gamma-ray energies between 0.35 and 10.6 MeV for coarse intervals in incident neutron energy. The integrated yield of gamma rays of energies greater than 350 keV with higher resolution in the neutron energy is also presented. Finally, the excitation function for the 440-keV gamma ray is given for incident neutron energies between 400 keV and 20 MeV. The experimental results are compared with the Evaluated Nuclear Data Files (ENDF).

51462 (ORNL/TM—6420) Measurement of the neutron total cross section of natural magnesium from 9 keV to 39 MeV. Larson, D.C.; Harvey, J.A.; Hill, N.W.; Weigmann, H. (Oak Ridge National Lab., Tenn. (USA)). Jun 1978. Contract W-7405-ENG-26. 65p. Dep. NTIS, PC A04/MF A01.

The neutron transmission through a 5.09-cm sample of natural magnesium was measured for neutron energies between 9 keV and 39 MeV. The Oak Ridge Electron Linear Accelerator (ORELA) was used to provide the neutrons, which were detected at the 200-m flight path by a NE-110 proton recoil detector. The experimental results are tabulated and compared with the total cross section in the ENDF/B-IV file for magnesium.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

51463 Comparison of two-dimensional and three-dimensional time-dependent Hartree-Fock for ^{40}Ca + ^{40}Ca at E/sub lab/ = 278 MeV. Flocard, H.; Weiss, M.S. (Division de Physique Theorique, Institute de Physique Nucleaire, B.P. Nol., 91406 Orsay, France). *Phys. Rev., C;* **18**: No. 1, 573-575(Jul 1978).

The results of time-dependent Hartree-Fock calculations in two and three dimensions are compared for ^{40}Ca + ^{40}Ca at E/sub lab/ = 278 MeV. The primary difference is the large fusion cross section calculated in three dimensions which is not present in two dimensions. Energy loss, scattering angle, and orbits are compared for a variety of impact parameters.

51464 (ORNL-tr—4560) Collisions of nuclei at relativistic energies: the evolution of a compression zone. Gudima, K.K.; Ive, Kh.; Toneev, V.D. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1977. Translation by S.D. Blalock Jr. of Preprint JINR—P2-10769. 15p. Dep. NTIS, PC A02/MF A01.

The compression of a nuclear material and the spatial-temporal evolution of a compression zone during central collisions are discussed on the basis of the cascade model. Angular distributions and pion number density are also noted. 23 references (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 51355

NUCLEAR REACTIONS AND SCATTERING

51465 Energy levels of ^{60}Fe populated by the ^{58}Fe (t,p)^{60}Fe reaction. Norman, E.B.; Davids, C.N.; Moss, C.E. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **18**: No. 1, 102-107(Jul 1978).

Thirteen levels below 3.8-MeV excitation in ^{60}Fe have been identified using the ^{58}Fe(t,p)^{60}Fe reaction. Analysis of the proton angular distributions has yielded spins and parities of most states observed below 3.1 MeV. The ground-state Q value is 6913 +- 4 keV, yielding a mass excess for ^{60}Fe of - 61404 +- 5 keV. The level structure of ^{60}Fe deduced from this experiment is compared with previous measurements and is discussed in terms of a vibrational model.

51466 Protons, deuterons, and tritons emitted from the reaction of 192-MeV ^{12}C with ^{56}Fe. Ball, J.B.; Fulmer, C.B.; Mallory, M.L.; Robinson, R.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **40**: No. 26, 1698-1701(26 Jun 1978).

Energy spectra and yields of Z = 1 particles from bombardment of an iron target with 192-MeV ^{12}C ions were measured at a number of angles between 8° and 65°. The spectra extend to energies far above the energy per nucleon of the incident projectile. The observed yields are consistent with an interpretation that projectile-like products of the nuclear collisions are excited sufficiently to evaporate one or more light particles subsequent to the collision.

51467 Hydrogen and helium production cross sections for ENDF/B-V. Stewart, L. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 740-741(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

51468 Compound and precompound emission of α particles in reactions of even Zn isotopes with low-energy protons and ^{4}He ions. Lux, C.R.; Porile, N.T. (Department of Chemistry, Purdue University, Lafayette, Indiana 47907). *Phys. Rev., C;* **18**: No. 1, 148-157(Jul 1978).

Energy spectra of α particles emitted in the reactions of ^{64}Zn, ^{66}Zn, ^{68}Zn, and ^{70}Zn with 12.5 MeV protons and 18 MeV ^{4}He ions were measured between 30° and 150° to the beam. The contribution of the precompound process was determined on the basis of the asymmetry in the angular distribution and by comparison of the spectra with calculations based on the compound and precompound models. Both methods indicate that the contribution of this process increases with target neutron number and is of greatest importance for the (α,α′) reaction. The ratio of α to neutron evaporation widths is found to depend strongly on target neutron number and a correlation is established with the corresponding separation energies.

51469 Scattering of fast neutrons by even isotopes of Zn. Korzh, I.A.; Mishchenko, V.A.; Mozhzhukhin, E.N.; Pravdivyi, N.M.; Sanzhur, I.E. (Nuclear Research Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 122-126(Aug 1977).

This work is part of a systematic study of scattering of fast neutrons by separated isotopes of intermediate nuclei. Measurements by the time-of-flight method are reported for the differential cross sections for elastic and inelastic scattering of neutrons with excitation of the first three levels of the isotopes /sup 64,66,68/Zn at neutron energies of 1.5, 2.0, 2.5, and 3.0 MeV. A theoretical analysis is given. It is shown that the scattering cross sections calculated according to the optical model and the Hauser-Feshbach statistical theory for the most part satisfactorily describe the experimental data.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

51470 Shell-model studies for the ^{132}Sn region. I. Few proton cases. Baldridge, W.J. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., C;* **18**: No. 1, 530-538(Jul 1978).

The Brueckner G matrix from the Reid soft-core potential is taken for the leading contribution of the effective two-proton interaction in the ^{132}Sn region. Phenomenological two-body pairing and multipole forces are added to adjust for all neglected effect. Two model spaces are selected; a small space [0g/sub 7/2/, 1d/sub 5/2/] and a large space [0g/sub 7/2/, 1d/sub 5/2/, 0h/sub 11/2/, 2s/sub 1/2/, 2s/sub 1/2/]. For each space the strengths of the phenomenological terms are adjusted to fit the ^{134}Te spectrum. It is found that both of the total interactions have a high statistical correlation with the bare G matrix. The total effective interactions are then used without further adjustment in shell model calculations to obtain good predictions for the spectra of ^{135}I, ^{136}Xe, and ^{137}Cs.

51471 Shell-model studies for the ^{132}Sn region. II. Exact and statistical results for multi-proton cases. Baldridge, W.J.; Dalton, B.J. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., C;* **18**: No. 1, 539-548(Jul 1978).

Level structures and level densities of nuclei consisting of a ^{132}Sn core plus as many as nine valence protons are calculated using a realistic effective interaction (G matrix) plus previously determined correction terms. The correction terms were determined so that the total interaction, when used in shell-model calculations, gave a fit to the observed ^{134}Te spectrum. Recently developed trace reduction methods are employed to determine the energy moments of the level densities for each spin value. Comparisions between these moments and results of exact shell-model diagonalizations show excellent agreement. Level density comparisons demonstrate that the effect of the necessary correction terms on the spectra is small and decreases as the number of allowed orbits increases. This level density method is also used to investigate the effects of the Coulomb force on the multi-proton spectra.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 51464

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 51473, 51474

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 51502

51472 (LBL—7713) **Study of the role of complete fusion in the reaction of ^{48}Ca and ^{56}Fe with cerium and terbium.** Morrissey, D.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1978. Contract W-7405-ENG-48. 82p. Dep. NTIS, PC A05/MF A01.

Thesis.

^{48}Ca and ^{56}Fe beams from the Super HILAC accelerator were used to irradiate thick metal foils of cerium and terbium. Product gamma ray activities were detected offline and individual products were identified by half-life, gamma ray energy and gamma ray abundances. The production cross sections were iteratively fit to charge and mass dispersions to allow correction for parent decay and calculation of mass yields. From the mass yield curves contributions from quasielastic transfer, deep inelastic transfer and complete fusion reaction mechanisms were interred. Complete fusion was made up on contributions from both evaporation residue and fusion-fission products for the ^{48}Ca induced reactions. However, only fusion-fission products were detected in the ^{56}Fe induced reactions. Critical angular momenta for fusion were found to be 82 +- 8 h for ^{48}Ca + ^{159}Tb and 34 +- 5 h for ^{56}Fe + ^{140}Ce, which can be compared with 53 +- 8 h for ^{12}C + ^{197}Au (Natowitz, 1970) and 86 +- 5 h for ^{40}Ar + ^{165}Ho (Hanappe, 1973). All of these reactions lead to essentially the same compound nucleus and seem to show the dramatic decline in complete fusion for heavy ions larger than ^{40}Ar. The prediction of this decline was found to be beyond the model calculations of Bass and the critical distance approach of Glas and Mosel.

51473 Neutron capture and transmission measurements on fission product palladium-107. Singh, U.N.; Block, R.C.; Nakagome, Y. (Rensselaer Polytechnic Inst., Troy, NY). *Nucl. Sci. Eng.;* **67**: No. 1, 54-60(Jul 1978).

Neutron capture and transmission measurements were made on a sample of fission-product palladium. The level parameters were obtained for 34 ^{107}Pd resonances below 700 eV. The observed average level spacing was $\langle D \rangle$ = (10.7 +- 1.5) eV, and the s-wave neutron strength function was determined to be 10^{4} S_0 = ($0.56^{+0.16}$/sub -0.12/). The capture width Gamma/sub γ/ for the 6.834-eV ^{107}Pd resonance was deduced to be (125 +- 15) meV. If all ^{107}Pd resonances have the same radiation width as the 6.834-eV

resonance, the resonance capture integral for all 34 resonances is 87 b. 3 figures, 2 ables.

51474 Capture cross-section measurements of ^{141}Pr. Feigenbaum, P.S. (Rensselaer Polytechnic Inst., Troy, NY); Singh, U.N.; Block, R.C. *Trans. Am. Nucl. Soc.;* **28**: 743-745(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51475 EBR-II irradiation of enriched isotopes of neodymium, samarium, and europium. Anderl, R.A. (EG and G Idaho, Inc., Idaho Falls); Harker, Y.D.; Tromp, R.L.; Delmore, J.E. *Trans. Am. Nucl. Soc.;* **28**: 745(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 51472

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

RADIOACTIVE DECAY

51476 ^{186}Os studied in the decay of 15.8-h ^{186}Ir and by the ^{186}W(α,4n)^{186}Os reaction. Spanhoff, R.; Postma, H.; Canty, M.J. (Laboratorium voor Algemene Natuurkunde, Rijksuniversiteit, Groningen, The Netherlands). *Phys. Rev., C;* **18**: No. 1, 493-515(Jul 1978).

New information about levels in the transitional nucleus /sup exclamation-point86/Os is gained from a study of the decay of 15.8-h ^{186}Ir. A significantly improved decay scheme was deduced from an extensive γ-γ coincidence measurement. Spins and parities were determined for many levels from a nuclear orientation study; in several cases measured electron-conversion data were useful. Spins for the proposed members of a γ band were confirmed, up to I = 6. In addition, detailed evidence for the existence of a K = 0 band, built upon the known 0^+ level at 1061 keV, is presented (2^+,4^+, and 6^+ members at 1209, 1461, and 1813 keV, respectively). Mixing ratios for interband transitions depopulating the members of both bands were determined from the nuclear orientation data, and are discussed. The deduced E2 branching ratios are fairly well reproduced in a band-mixing calculation incorporating these bands. An absolute value of 2.8 +- 0.3 μ/sub N/ for the magnetic moment of ^{186}Ir is reported, and is discussed in terms of coupling of Nilsson states; the assignment $\{7/2^+[404]\pi; 3/2^-[512]\nu\}5^-$ is proposed. Results of a study of the ^{186}W(α,4n)^{186}Os reaction, including γ, γ-γ, γ (θ), and γ-t measurements, confirm the results of the decay study. In addition, two isomeric states were identified, at 1774 keV (8.1 ns) and at 2165-keV (5.3 ns). Side-feeding of negative parity levels was observed.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 51476

51477 Collective excitations in ^{158}Dy as populated in radioactive decay of ^{158}Ho/sup g/,m. Anderson, D.L.; Brenner, D.S.; Meyer, R.A. (Jeppson Laboratory, Clark University, Worcester, Massachusetts 01610). *Phys. Rev., C;* **18**: No. 1, 383-400(Jul 1978).

The levels of ^{158}Dy populated in the decay of 11-min ^{158}Ho/sup g/ and 28-min ^{158}Ho/sup m/ in equilibrium with 2.3-h ^{158}Er have been studied using singles Ge(Li) detectors, a Compton-suppression spectrometer and a Ge(Li) -Ge(Li) coincidence spectrometer. We firmly establish K = 0 one-phonon β-vibrational, K = 2 one-phonon γ-vibrational, K = 2 two-phonon (β + γ) vibrational, and K = 4 two-quasineutron bands with new γ-ray singles, coincidence, and multipolarity evidence. Members of the K = 0, 1, 2, and 3 octupole vibrational bands are identified and compared to theoretical calculations. One-phonon octupole vibrational bands are proposed with the following assignments I/sup π/(keV): K = 0: 1^-(1608.0), 3^-(1671.8), 5^-(1818.7); K = 1: 1^-(1441.7), 2^-(1501.1), 3^-(1513.6), 4^-(1618.4), 5^-(1634.5); K = 2: 2^-(1371.7), 3^-(1397.2), 4^-(1518.5), 5^-(1528.1); and K = 3: 3^-(2409.6). A limiting value rho > or = 0.09 has been measured for the monopole matrix element of the 990.6-keV β vibration and a new low-lying 0^+ state is reported at 1710.2 keV which may have collective character.

51478 Decoupled bands and shape coexistence in neutron deficient Gd nuclei. Kleinheinz, P.; Sheline, R.K.; Maier, M.R.; Diamond, R.M.; Stephens, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nukleonika;* **20**: No. 2, 163-167(1975).

From 7. summer school on nuclear physics; Mikolajki, Poland (2 - 15 Sep 1974).

The (α, xn, γ) reaction on a series of odd and even Sm targets has been used to study the level structure of ^{147}Gd, ^{149}Gd, ^{151}Gd. Detailed results are given for ^{151}Gd. A variety of criteria show conclusively that in ^{151}Gd two bands with very different deformations are observed - one, an i/sub 13/2/ decoupled band with small prolate deformation of β = +0.14, the other, a normal rotational band with prolate deformation of β=+0.29 associated with the h/sub 11/2/ hole excitation. A simple explanation for these two different shapes, based on the Nilsson diagram, is presented.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 51472, 51480

51479 (COO—1672-73) Radiochemical investigations of nuclear properties. Progress report, October 1, 1976—September 30, 1977. Daly, P.J. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Chemistry). Sep 1977. Contract EY-76-S-02-1672. 16p. Dep. NTIS, PC A02/MF A01.

Progress in experimental investigations of high spin excitations in spherical and transitional nuclei in the A = 180 to 204 mass range is described. Most of the experiments were performed by in-beam γ-ray spectroscopy using beams of ^{3}He, ^{4}He, and ^{12}C ions from the Michigan State University cyclotron. The main results of studies of the nuclei $^{195\ 197\ 199\ 201\ 202\ 203}$Pb, $^{196\ 197\ 199\ 200}$Hg and $^{186\ 187\ 188\ 189}$Pt are summarized.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 51472

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 51456, 51479

51480 (LBL—7168) Dependence of deep-inelastic processes on entrance channel asymmetry and excitation energy. Schmitt, R.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1978. Contract EY-76-C-04-0789. 189p. Dep. NTIS, PC A09/MF A01.

Thesis.

The dependence of deep-inelastic processes on entrance channel asymmetry and on excitation energy was investigated. Thin targets of /sup nat/At, ^{159}Tb, ^{181}Ta and ^{197}Au were bombarded with 620 MeV ^{86}Kr ions. Additional measurements were performed on the reactions /sup nat/Ag + ^{86}Kr and ^{197}Au + ^{86}Kr at 506 and 732 MeV incident energy. The energy spectra, the charge distributions and the angular distributions of these fragments were measured. At 620 MeV the energy spectra show that the distinction between quasi-elastic and deep-inelastic processes diminishes as the target mass is increased. The charge distributions, which are peaked at symmetry for /sup nat/Ag, tend to become increasingly asymmetric for the heavier systems. Likewise, the angular distributions exhibit a strong dependence on the entrance channel asymmetry. For the lightest system, /sup nat/Ag + ^{86}Kr, the angular distributions are essentially forward peaked, aside from a separable quasi-elastic component. For the heaviest system, ^{197}Au + ^{86}Kr, the angular distributions are side-peaked. The transition between these two regimes occurs smoothly with increasing target mass. The results at 506 and 732 MeV show that the widths of the charge distributions are strongly dependent on the excitation energy. The angular distributions for the reaction /sup nat/Ag + ^{86}Kr become increasingly more forward peaked at higher bombarding energies. The angular distributions for ^{197}Au + ^{86}Kr, which are strongly focused at 506 MeV, also tend to be more forward peaked at the highest incident energy. The results are interpreted by assuming that the projectile and target form an intermediate complex and that they exchange mass via a diffusion process. Because of the systematic nature of this study, the data should serve as a guide in the development of models of deep-inelastic processes.

51481 (LBL—7192) Emission of heavy charged particles in relativistic nucleus—nucleus collisions. Stevenson, J.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1977. Contract W-7405-ENG-48. 85p. Dep. NTIS, PC A05/MF A01.

Thesis.

The energy and angular distributions of nuclei produced in interactions of 500 MeV/nucl ^{40}Ar projectiles with an Au target

were investigated. Nuclei with charge 3 < or = to Z < or = to 11 were observed. Single particle inclusive spectra were obtained at angles between 35 and 85°, in the energy range 20 to 60 MeV/nucl. The spectra decrease monotonically with the increasing energy, angle, and charge. The distributions are consistent with an isotropically emitting source recoiling with an average velocity of aproximately 0.08 c in the beam direction. Thermal model fits to the data yield temperatures tau of about tau approximately 60 MeV. The low recoil velocity and high temperature are shown to be in conflict with energy and momentum conservation. Two nonthermal models of emission involving expansion or rotation are explored. Although neither of these models gives good quantitative fits to the data, they do much better than the thermal model if it is constrained to be energy and momentum conserving. The data for all energies, angles and species may be simply parameterized. When transformed into a recoiling source frame with β_0 approximately equal to 0.08, all data points lie near (+-4x) a common curve, for which the invariant cross section, f identical with (1/p) (d² sigma/dΩdE), falls exponentially with increasing momentum, f varies as e/sup ¯p/p/sub c//, with a characteristic momentum p/sub c/ approximately equal to 340 MeV/c.

51482 Energy dependence of elastic scattering and one-nucleon transfer reactions induced by ^{16}O on ^{208}Pb. I. Pieper, S.C.; Macfarlane, M.H.; Gloeckner, D.H.; Kovar, D.G.; Becchetti, F.D.; Harvey, B.G.; Hendrie, D.L.; Homeyer, H.; Mahoney, J.; Puehlhofer, F.; von Oertzen, W.; Zisman, M.S. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **18**: No. 1, 180-204(Jul 1978).

Elastic scattering for ^{16}O on ^{208}Pb and the single-nucleon transfer reactions ^{208}Pb(^{16}O,^{15}N) ^{209}Bi and ^{208}Pb(^{16}O,^{17}O) ^{207}Pb have been measured at bombarding energies of 104, 138.5, and 216.6 MeV. A detailed optical model analysis of ^{16}O on ^{208}Pb elastic data from 80 to 216.6 MeV has been made. The Woods-Saxon potential parameters must be energy dependent to accurately reproduce the elastic data. Finite-range distorted-wave Born-approximation calculations employing both energy- independent and energy-dependent optical potentials are compared with the transfer data. With the exception of small shifts in angle, the distorted-wave Born approximation correctly predicts the shape of the angular distributions and the evolution of the relative single-particle strengths as functions of the bombarding energy. However, the distorted-wave Born approximation fails (by a factor of 2 to 3) to predict the observed energy dependence of the absolute single-particle transfer strength. It is demonstrated that this failure is not likely to be corrected by changes in the bound-state or optical-model potentials, if Woods-Saxon forms that fit the elastic data are used.

51483 Energy dependence of elastic scattering and one-nucleon transfer reactions induced by ^{16}O on ^{208}Pb. II. Olmer, C.; Mermaz, M.; Buenerd, M.; Gelbke, C.K.; Hendrie, D.L.; Mahoney, J.; Scott, D.K.; Macfarlane, M.H.; Pieper, S.C. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., C;* **18**: No. 1, 205-222(Jul 1978).

The elastic scattering and single-nucleon stripping reactions induced by 312.6 MeV ^{16}O on ^{208}Pb are investigated and compared with data at lower incident energies. Distorted-wave Born approximation analyses account rather well for the relative final-state yields at each energy, but fail to reproduce the absolute energy dependence of the observed transfer cross sections.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

51484 Nuclear excitation rate. Doolen, G.D. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **40**: No. 26, 1695-1698(26 Jun 1978).

The rate at which the first nuclear state becomes populated is calculated as function of temperature and compression for ^{238}U.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 51508

SPONTANEOUS AND INDUCED FISSION

51485 Calculation of spontaneous fission properties of very heavy nuclei: 98 < or = Z < or = 106 and 150 < or = N < or = 164. Mustafa, M.G.; Ferguson, R.L. (Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., C;* **18**: No. 1, 301-310(Jul 1978).

The transition points in Z and N at which the preference for fragment mass asymmetry changes to symmetry are calculated for spontaneous fission of even-even nuclei with 98 < or = Z < or = 106 and 150 < or = N < or = 164. The study is based on the minimum potential energy surface calculations with the asymmetric two-center shell model. The nuclear shapes are constrained either to a fixed value or in some cases to several values of the neck radius, connecting the two halves of the fissioning nucleus. The other shape parameters (including mass asymmetr and elongation) are allowed to vary to obtain the minimum potential energy surface. The potential energy surface calculations are also carried out for the two odd nuclei, ^{257}Fm and ^{262}105, for which experimental data on fragement-mass distribution are available. The calculated transition points and the currently available experimental data appear to be in agreement. The fission barriers are aslo calculated. It is found that, unlike Fm isotopes for whch the second barrier disappears for N > 154, the second barrier remains in elements 102 and 104 for N > 154. These barriers are, however, found to be below the ground state and to disappear eventually for large N. The fission of ^{262}105 is discussed in detail and it is argued that this nucleus and also others in this mass region fission adiabatically.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

51486 Decay of ^{230}Ra and ^{230}Ac. Gilat, J.; Katcoff, S. (Brookhaven National Lab., Upton, N.Y. (USA)). *J. Inorg. Nucl. Chem.;* **40**: No. 3, 369-375(1978).

^{230}Ra and its Ac daughter were produced by the ^{232}Th (n,2pn) reaction at the Brookhaven Medium Energy Intense Neutron facility. Thorough chemical separations were developed which facilitated the characterization of these nuclides. The half-lives ı re 93 + - 2 min and 122 + -3 sec for ^{230}Ra and ^{230}Ac, respectively. Energies and relative intensities of 35 γ-rays from ^{230}Ra decay and 93 γ-rays from ^{230}Ac decay, are tabulated. Preliminary Q/sub β/ results are approximately 0.80 MeV for ^{230}Ra and approximately 2.70 MeV for ^{230}Ac. ^{229}Ra was identified and shown to decay with T/sub 1/2/ = 4.1 + - 0.3 min. Effective medium energy neutron cross sections are given for production of $^{223\ 224\ 225\ 227\ 230}$Ra isotopes from Th and U.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 51486

51487 (ANL/NDM—42) **Fast neutron radiative capture cross section of ^{232}Th.** Poenitz, W.P.; Smith, D.L. (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 28p. Dep. NTIS, PC A03/MF A01.

The ^{232}Th(n,γ) cross section was measured between 30 keV and 2.5 MeV. A large liquid scintillator was used to measure the shape of the cross section relative to Au(n,γ) between 58 keV and 850 keV. The activation technique was used in measurements at 30 keV relative to Au(n,γ) and above 240 keV relative to ^{235}U(n,f). The activation results were utilized to normalize the shape data. The results agree well with recent experimental data by Lindner et al. and are substantially lower than the evaluated data file ENDF/B-IV in the several-hundred-keV range.

51488 Review of fast integral data related to ^{233}U and thorium. Beck, C.L. (Argonne National Lab., Idaho Falls); Lineberry, M.J.; Schaefer, R.W.; Carpenter, S.G.; Wade, D.C.; Ducat, G.A. *Trans. Am. Nucl. Soc.;* **28**: 715-717(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51489 Testing of ENDF/B-IV thorium data in a GCFR lattice. Gmuer, K.; McCombie, C.; Richmond, R.; Schmocker, U.; Seth, S. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). *Trans. Am. Nucl. Soc.;* **28**: 719(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51490 Evaluation of the neutron-induced reactions for ^{233}U. Stewart, L.; Madland, D.G.; Young, P.G. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **28**: 721-722(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 51488

51491 (ANL/NDM—36) **Absolute measurements of the ^{233}U (n,f) cross section between 0.13 and 8.0 MeV.** Poenitz, W.P. (Argonne National Lab., Ill. (USA)). Apr 1978. Contract W-31-109-ENG-38. 29p. Dep. NTIS, PC A03/MF A01.

The fast neutron fission cross section of ^{233}U was measured absolutely between 0.13 and 8.0 MeV. The absolute cross section values were obtained by low geometry alpha counting and isotopic dilution analysis of various ^{233}U samples, 2π-detection of the fission fragments with an ionization chamber, and the measurement of the neutron flux with several black neutron detectors. Absolute cross sections were obtained with a 2 to 3% uncertainty over the most important energy range.

51492 **Status of nuclear data for ^{232}Th and ^{233}U.** Steen, N.M. (Westinghouse Electric Corp., West Mifflin, PA). *Trans. Am. Nucl. Soc.;* **28**: 712-714(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51493 **Measurement of the ^{232}Th(n,f) cross section from 1 eV to 20 keV.** Block, R.C. (Rensselaer Polytechnic Inst., Troy, NY); Nakagome, Y.; Slovacek, R.E.; Bean, E.B. *Trans. Am. Nucl. Soc.;* **28**: 719-721(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51494 **Calculated fission product yields for fast-neutron fission of ^{238}U.** Gindler, J.E.; Glendenin, L.E. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 747-748(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51495 **Calculations of delayed-neutron yields from ENDF/B-VC.** Liaw, J.R. (Univ. of Oklahoma, Norman); England, T.R. *Trans. Am. Nucl. Soc.;* **28**: 750-752(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51496 **Quadrupole photofission of ^{232}Th and role of symmetry of the nucleus in the fission process.** Zhuchko, V.E.; Kapitza, S.P.; Ostapenko, Y.B.; Smirenkin, G.N.; Soldatov, A.S.; Tsipenyuk, Y.M. (Institute of Physics Problems, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 10, 553-555(20 Nov 1977).

An increase in the quadrupole component of the angular distribution of the fragments was observed deep below the photofission barrier of ^{232}Th. We discuss the influence of the symmetry of the saddle configurations in the double-hump-barrier model on the spectrum of the fission channels of even-even nuclei and the resonant structure of the cross section.

51497 **Experimental study of fission of U and Th by /sup 40,44,48/Ca ions.** Kalpakchieva, R.; Oganesyan, Y.T.; Penionzhkevich, Y.E.; Polyanskii, V.N.; Bruchertseifer, H.; Gavrilov, K.A.; Sek, C.V. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 131-134(Aug 1977).

Experimental results are presented on a study of the isotopic and mass distributions of fission fragments formed in bombardment of U and Th by ions of /sup 40,44,48/Ca. Values are obtained for the cross sections for compound-nucleus formation in these reactions, and also their dependence on the energy of the Ca ions.

NUCLEAR THEORY

NUCLEAR STRUCTURE

51498 **Calculation of the kinetic energy of the motion of the center of mass of a nucleus in the α-cluster model with single-particle functions having realistic asymptotic forms.** Kinchakov, V.S. (Khabarovsk Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 136-139(Aug 1977).

A method is proposed for calculating the kinetic energy of the motion of the mass center of a nucleus in the α-cluster model with single-particle functions having realistic asymptotic forms. It is shown that this kinetic energy depends on the spin of the rotational states. The energy characteristics of the nuclei ^{4}He and ^{8}Be are calculated in the Brink model with functions having exponential asymptotic forms.

51499 **Effects of violation of Galilean invariance of pairing.** Pyatov, N.I.; Gabrakov, S.I.; Salamov, D.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 139-142(Aug 1977).

We discuss the violation of Galilean invariance of pairing interactions in a giant dipole resonance. A self-consistent form of the symmetry-restoring pair interaction, with angular momentum and parity 1^{-}, is obtained on the basis of the hypothesis of the Galilean invariance of the pairing. The consequence of allowance for these interactions is considered.

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 51425, 51503

NUCLEAR REACTIONS AND SCATTERING

51500 (ANL—76-11(Rev.1)) **Ptolemy: a program for heavy-ion direct-reaction calculations.** Macfarlane, M.H.; Pieper, S.C. (Argonne National Lab., Ill. (USA)). Apr 1978. Contract W-31-109-ENG-38. 109p. Dep. NTIS, PC A06/MF A01.

Ptolemy is an IBM/360 program for the computation of nuclear elastic and direct-reaction cross sections. It carries out optical-model fits to elastic-scattering data at one or more energies and for one or more combinations of projectile and target, collective model DWBA calculations of excitation processes, and finite-range DWBA calculations of nucleon-transfer reactions. It is fast and does not require large amounts of core. The input is exceptionally flexible and easy to use. The types of calculations that Ptolemy can carry out are outlined, the formulas used are summarized, and a detailed description of its input is given.

51501 (ANL/NDM—40) **Statistical theory of neutron nuclear reactions.** Moldauer, P.A. (Argonne National Lab., Ill. (USA)). Feb 1978. Contract W-31-109-ENG-38. 47p. Dep. NTIS, PC A03/MF A01.

The statistical theory of average neutron nucleus reaction cross sections is reviewed with emphasis on the justification of the Hauser Feshbach formula and its modifications for situations including isolated compound nucleus resonances, overlapping and interfering resonances, the competition of compound and direct reactions, and continuous treatment of residual nuclear states.

51502 (BNL-NCS—24249) **Non-statistical effects in neutron capture.** (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 64p. (CONF-780463—1). Dep. NTIS, PC A04/MF A01.

From 3. international school on neutron physics; Alushta, USSR (19 Apr 1978).

Lectures are presented describing present understanding of departures from the extreme statistical model in radiative s- and p-wave neutron capture in the resonance as well as the thermal regions in terms of simple reaction mechanisms. Supporting evidence from inverse threshold photonuclear reactions is also presented. While an exhaustive study is not made, the most interesting examples are treated. Also spin and parity determinations and recent developments in the understanding of M1 transitions are considered. It is concluded that nonstatistical effects in both s- and p-wave radiative neutron capture do exist in the thermal and resonance region. The gamma ray energy dependence of the partial decay widths provide a signature of the type of reaction mechanism. 94 references. (JFP)

51503 (ORO—4856-59) **Theoretical studies in nuclear reaction and nuclear structure. Final report, January 1, 1975—June 30, 1976.** Banerjee, M.K.; Griffin, J.J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1977. Contract EY-76-C-05-4856. 32p. Dep. NTIS, PC A08/MF A01.

Research on theoretical nuclear reactions and structure is summarized. A list of publications is included. (JFP)

NUCLEAR MOMENTS AND SPIN

51504 **Schematic model for isospin mixing in light nuclei.** McDonald, A.B.; Adelberger, E.G. (Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario K0J 1J0, Canada). *Phys. Rev. Lett.;* **40**: No. 26, 1692-1695(26 Jun 1978).

A schematic model is used to calculate isospin-mixing from charge-dependent matrix elements derived from mass difference of isobaric multiplets. The model reproduces isospin-mixing matrix elements and trends observed in isospin-forbidden particle decays.

SPONTANEOUS AND INDUCED FISSION

51505 **Treatment of a two-dimensional fission model with complex trajectories.** Ring, p. (Technische Univ. Muenchen, Garching (Germany, F.R.). Physik-Dept.); Massmann, H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)); Rasmus-

sen, J.O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., A;* **296**: No. 1, 50-76(13 Feb 1978).

The tunneling problem through multidimensional fission barriers is studied in a simple two-dimensional model. The uniform semiclassical approximation with complex classical trajectories is applied, and the results are compared with an exact quantum-mechanical solution by a coupled-channels calculation. The results show very good agreement.

51506 Kinetic energy of fission fragments at small excitation energies. Geilikman, B.T. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 134-136(Aug 1977).

Based on the quasi-static model of fission, an explanation is given of the experimentally observed complex dependence of the fragment kinetic energy on the energy E_0 delivered to the fissioning nucleus for small E_0.

51507 Calculation of absolute and relative decay widths of strongly excited nuclei in a model with constant temperature. Kamanin, V.V.; Karamyan, S. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 147-153(Aug 1977).

It is shown that in a model with constant temperature (nuclear level-density function rho (E) ~e/sup E//T) it is possible to describe at the same time, with good accuracy, the experimental data on the ratios Γ/sub f//Γ/sub n/ and on the lifetimes of compound nuclei in the excitation energy range 50—100 MeV. Some problems concerning the physical premises of the model and its relation to the Fermi-gas model are considered.

NUCLEAR MODELS

51508 Model for high-energy heavy-ion collisions. Myers, W.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., A;* **296**: No. 1, 177-188(13 Feb 1978).

A model is developed for high-energy heavy-ion collisions that treats the variation across the overlap region of the target and projectile in the amount of energy and momentum that is deposited. The expression for calculating any observable takes the form of a sum over a series of terms, each one of which consists of a geometric, a kinematic, and a statistical factor. The geometrical factors for a number of target—projectile systems are tabulated.

51509 Collective coordinates in the random phase approximation and the systematics of giant multipole resonances. Semenko, S.F. (P. N. Lebedev Physical Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 143-146(Aug 1977).

The equation for the collective coordinate proposed earlier by the author is solved for a rectangular one-particle potential and residual density-dependent δ-function forces. The results include as a particular case the equations of the hydrodynamic models. The properties of the giant multipole resonances with $l = or = 2$ are systematized in the framework of the present approach.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 51619

51510 (CONF-780622—27) **Medium-energy nucleon—meson transport calculation and electronuclear fuel production.** Alsmiller, R.G. Jr.; Gabriel, T.A.; Barish, J. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Medium-energy transport calculations to evaluate the nuclear performance of some target—blanket designs for electronuclear fuel production are discussed. The number of neutron captures and fissions is given for the various regions and materials in a typical target—blanket assembly. Also tabulated is the energy deposition in the various regions. 1 figure, 1 table. (RWR)

51511 (SAND—78-0173C) **Application of optimal interation strategies to diffusion theory calculations.** Jones, R.B. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 5p. (CONF-780622—19). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Portions of document are illegible.

The geometric interpretation of optimal (minimum computational time) iteration strategies is applied to one- and two-group, two-dimensional diffusion-theory calculations. The method is a "spectral/time balance" technique which weighs the convergence enhancement of the inner iteration procedure with that of the outer iteration loop and the time required to reconstruct the source. The diffusion-theory option of the discrete-ordinates transport code DOT3.5 was altered to incorporate the theoretical inner/outer decision logic. For the two-dimensional configuration considered, the optimal strategies reduced the total number of iterations performed for a given error criterion.

51512 Benchmark gamma-ray skyshine experiment: measurements and calculations. Shultis, J.K. (Kansas State Univ., Manhattan); Clifford, C.E.; Faw, R.E.; Yoon, W.; Roseberry, M.; Nason, R. *Trans. Am. Nucl. Soc.;* **28**: 632-633(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

SHIELDING CALCULATIONS AND EXPERIMENTS

REFER ALSO TO CITATION(S) 50820

51513 (DP-MS—77-83) **Shielding for cylindrical sources.** Langhaar, J.W. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1977. Contract EY-76-C-09-0001. 10p. (CONF-780506—13). Dep. NTIS, PC A02/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

Guidelines are presented to shielding cask designers in the use of the computer codes ANISN and SDC for a cylindrical radiation source, and data are given on the effectiveness of cylindrical shields (customary for casks) compared with flat slab shields (assumed in SDC and in usual manual calculations). For illustration, calculations with ANISN and SDC were made for a homogeneous cylindrical source of 40 cm radius. Also included are examples of the effectiveness of water and uranium for neutron shielding. (GHT)

51514 Calculations of several CSEWG shielding benchmarks with preliminary ENDF/B-V data. Maerker, R.E. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 737-738(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51515 Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Contract W-7405-ENG-26. Princeton, NJ; Science Press (1977). 944p. (CONF-770401—). $45.00.

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

Topics covered in the conference include: overview-methods and design; sensitivity analysis; design experience; radiation damage and streaming; occupational exposure; corrosion and fission products; integral experiments; information resources and standards, and fusion and advanced reactors. Abstracts of 76 of the papers were prepared for the data base. (GHT)

51516 Evolution of shielding methods and data: a continuing process of adjustment to changing project needs. Butler, J. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 11-21 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

Developments of shielding methods and data-sets in countries outside the USA have their origins in the continuing demands from a variety of different reactor projects for fast and reasonably accurate methods to accomplish modest extrapolations from mock-up experiments to practical design problems. The adjustment of semi-empirical methods based on kernel, albedo and diffusion theory approximations has played a central role, underpinned--but not displaced--by rapidly developing transport methods, following in the wake of the classic work on the method of moments which still provides useful data for designers in the form of build-up factors for gamma-ray calculations. The thrust of European effort on transport codes has been directed towards Monte Carlo, with some notable developments of discrete-ordinate methods in Japan and elsewhere. The most widely used S/sub n/ codes, however, are ANISN and DOT; their popularity reflects the invaluable service provided by RSIC at Oak Ridge in disseminating a variety of US codes and data sets to the international shielding community. With recent developments in the techniques of sensitivity analysis, it has become clear that the currently available data sets are not adequate to meet the target accuracies laid down for some of the more important problems in the shielding of advanced-thermal and fast-breeder reactor plants. The application of transport codes for the solution of these problems has led, in turn, to the use of integral benchmark experiments for the adjustment of data--in both multigroup form, and in a more fundamental way by the so-called consistent approach--in order to extend

the range and accuracy of the extrapolations from shield mock-up experiments. Such definitive calculations, however, are often cumbersome and expensive: simpler methods are still required for rapid survey studies.

51517 Survey of cross section sensitivity analysis as applied to radiation shielding. Goldstein, H. (Columbia Univ., New York). pp 75-90 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

Cross section sensitivity studies revolve around finding the change in the value of an integral quantity, e.g., transmitted dose, for a given change in one of the cross sections. A review is given of the principal methodologies for obtaining the sensitivity profiles--principally direct calculations with altered cross sections, and linear perturbation theory. Some of the varied applications of cross section sensitivity analysis are described, including the practice, of questionable value, of adjusting input cross section data sets so as to provide agreement with integral experiments. Finally, a plea is made for using cross section sensitivity analysis as a powerful tool for analysing the transport mechanisms of particles in radiation shields and for constructing models of how cross section phenomena affect the transport. Cross section sensitivities in the shielding area have proved to be highly problem-dependent. Without the understanding afforded by such models, it is impossible to extrapolate the conclusions of cross section sensitivity analysis beyond the narrow limits of the specific situations examined in detail. Some of the elements that might be of use in developing the qualitative models are presented.

51518 (ORNL-tr—4462) **Design of gas-filled double-bend ducts in concrete shields against gamma radiation: proportionment of the duct and the embedded iron layers for point source radiation and collimated radiation. DIN 25 427, Part 2.** (DIN Deutsches Inst. fuer Normung e.V., Berlin (Germany, F.R.)). [nd]. Translated by J. Lee from the German, Deutsche Normen, October 1977, 6p. 11p. Dep. NTIS, PC A02/MF A01.

The standard gives guidelines for the geometric proportioning of the duct and of the additional iron insertions which are necessary in order to reduce the entering radiation in all directions, at least to the extent that behind a shield dimensioned to satisfy shielding requirements only a local increase in the dose rate of a given fraction as compared to the dose rate behind the massive wall will occur. The standard is valid for the design of the dimensions and the necessary iron wall insertions in the case of gas-filled ducts with rectangular or circular cross sections that are bent twice at right angles in ordinary concrete shields against gamma radiation from nuclear reactions, nuclear processing plants, and caves. It is not valid for neutron radiation. (JFP)

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 50194, 50195, 51462

51519 Resonances in the reflection of ultracold neutrons. Zubarev, A.L. (Tashkent State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. ?, 232-233(Aug 1977).

Schwinger's variational principle is used to calculate the interactions of ultracold neutrons with a potential barrier. (AIP)

51520 Possibility of "accelerating" thermal neutrons. Zaretskii, D.F.; Lomonosov, V.V. (I. V. Kurchatov Atomic Energy Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 233-234(Aug 1977).

Calculations are presented concerning the acceleration of neutrons on passage through a medium containing a large number of molecules excited by laser radiation. (AIP)

51521 (ORNL-tr—4460) **Classification of concretes for neutron shielding with respect to atomic composition: DIN 25 413.** (DIN Deutsches Inst. fuer Normung e.V., Berlin (Germany, F.R.)). 1977. Translated by J. Lee from German Standard DIN 25 413, March 1976, 5p. 12p. Dep. NTIS, PC A02/MF A01.

The atomic compositions given in this standard are intended to standardize the assumptions about the atomic composition of the concrete to be used in order to yield calculations having fewer inaccuracies due to differing compositions in raw materials. The compositions are valid for design calculations dealing with concrete shields having a great radiation attenuation factor which are used in nuclear power plants, at research reactors, and other sources of intense neutron radiation. Heat release caused by the neutron field or activation and secondary gamma radiation in the shielding is not covered by this standard. (JFP)

51522 Computational scheme for energy group boundary selection using sensitivity theory. Herrnberger, V. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). pp 91-100 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

On the basis of sensitivity profiles, of required target accuracies and of the cost-benefit relationship of the iterative transport codes to be employed, a computational scheme for energy group boundary selection is presented. Initial applications to two shielding benchmarks for neutron transport in air and in a PWR configuration resulted in useful few group libraries. However, the conditions at present imposed on the condensation scheme are still rather severe, so that the few group libraries calculate the target quantities with somewhat higher accuracies than those actually required.

51523 Three-dimensional effects in sensitivity studies. Rief, H. pp 112-119 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

The primary aim of sensitivity calculations carried out by Monte Carlo techniques is a two and three-dimensional sensitivity analysis in shielding problems where ducts and heterogeneities are of primary importance. The mathematical formulation of this problem is based on the solution of the "forward equation" and correlated sampling where the same tracks are used in the perturbed and the unperturbed case. Since in this technique the perturbed history is using the collision density functions of the unperturbed case, additional weight factors must be introduced. If necessary fluxes and their sensitivity profiles can be calculated at points by the use of the "last collision estimator" of the "once more collided estimator". So far mainly one and multigroup calculations in spherical geometries have been performed and compared with equivalent ANISN-SWANLAKE runs. Space-dependent calculations using one energy group were performed for a sphere with a central isotropic source, emitting neutrons only into one hemisphere. As a first application to shielding benchmark experiments the transmission of neutrons through iron slabs (measured at the fast source reactor YAYOI) has been calculated. In this analysis energy and space dependent sensitivity profiles have been determined.

51524 Review of progress in the NEA/IAEA collaborative programme of sensitivity studies and shielding benchmarks. Butler, J. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 121-131 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

The collaborative program of sensitivity studies and shielding benchmarks was initiated by the NEACRP in June 1973 with the aim of co-ordinating work on the assessment of data for shielding calculations and exchanging results of benchmark experiments. Major progress has been made by all the participating laboratories, particularly with the exploitation of the ANISN/SWANLAKE route for sensitivity analysis; the development of correlated tracking Monte Carlo codes for more complicated geometries; the establishment of international standards for the design, analysis and reporting of benchmark experiments; and the understanding of their role in relation to differential measurements for the improvement of data libraries in use for practical design calculations. It is already clear from the first results of the systematic data studies conducted under this program, utilizing sensitivity analysis in conjunction with a generally agreed statement of target accuracies, that the format and content of those sections of the WRENDA List which deal with shielding requests will need substantial revision. This paper was prepared at the request of the NEACRP to draw the attention of the international shielding community to the continuing program of collaborative work, to review briefly the program which has been achieved and to give an indication of future developments.

51525 Effects of square-well cross section minima on the deep penetration of neutrons. Peng, W.; Goldstein, H. (Columbia Univ., New York). pp 149-156 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From National Transportation Safety Board meeting; Washington, DC, USA (24 Jan 1977).

See CONF-770104—.

A parametric study has been made of the effect of a square-well minimum on the penetrating neutron flux in a medium exhibiting only elastic scattering with otherwise constant cross sections. For this purpose a specialized moments-method computer code has been constructed which permits the calculation of the even spatial moments of the scalar flux, phi/sub 2n/ through 2n = 80. The results can be described by a convolution-of-sources model involving only the lethargy separation between detector and source, the width and relative depth of the minimum. On the basis of the

computations and the corresponding model it is possible to predict e.g. the conditions under which transport in the region of the minimum completely determines the penetrating flux. At the other extreme, the model describes when transport in the minimum can be treated in the same manner as in any comparable lethargy interval. With the aid of these criteria it is possible to understand the apparent paradoxical effects of certain minima in neutron penetration through such media as iron and sodium.

MEDICAL PHYSICS

RADIATION PROTECTION STANDARDS

REFER ALSO TO CITATION(S) 50454

51526 (FDA—77-8017) **Nationwide evaluation of x-ray trends: organ dose index system. Radiographic field survey procedures handbook.** (Food and Drug Administration, Washington, D.C. (USA)). Jan 1977. 54p. GPO $0.80.

This handbook contains the entire Section II "Radiographic Field Survey Procedures," of the NEXT Instruction Manual, as well as the pre edit criteria, post edit criteria, and error coding from Section IV. The information has been reprinted in this format for the convenience of field surveyors. Nothing has been added to the excerpted material.

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

REFER ALSO TO CITATION(S) 51512, 51526

DOSIMETRY

REFER ALSO TO CITATION(S) 50257, 51196, 51444

51527 (UCRL—80343) **Fabrication of a tissue-equivalent torso phantom for intercalibration of in-vivo transuranic-nuclide counting facilities.** Griffith, R.V.; Dean, P.N.; Anderson, A.L.; Fisher, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1978. Contract W-7405-ENG-48. 17p. (CONF-780612—6). Dep. NTIS, PC A02/MF A01.

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

A tissue-equivalent human-torso phantom has been constructed for calibration of the counting systems used for in-vivo measurement of transuranic nuclides. The phantom contains a human male rib cage, removable model organs, and includes tissue-equivalent chest plates that can be placed over the torso to simulate people with a wide range of statures. The organs included are lungs, heart, liver, kidneys, spleen, and tracheo-bronchial lymph nodes. Polyurethane with different concentrations of calcium carbonate was used to simulate the linear photon-attenuation properties of various human tissues—lean muscle, adipose-muscle mixtures, and cartilage. Foamed polyurethane with calcium carbonate simulates lung tissue. Transuranic isotopes can be incorporated uniformly in the phantom's lungs and other polyurethane-based organs by dissolution of the nitrate form in acetone with lanthanum nitrate carrier. Organs have now been labelled with highly pure ^{238}Pu, ^{239}Pu, and ^{241}Am for calibration measurements. This phantom is the first of three that will be used in a U.S. Department of Energy program of intercomparisons involving more than ten laboratories. The results of the intercomparison will allow participating laboratories to prepare sets of transmission curves that can be used to predict the performance of their counting systems for a wide range of subject builds and organ depositions. The intercomparison will also provide valuable information on the relative performance of a variety of detector systems and counting techniques.

SOLID STATE PHYSICS

51528 (COO—4381-2) **Study of inhomogeneous solid adlayers at electrolyte-solid interfaces using differential reflectance spectroscopy. Progress report, July 1, 1977—February 28, 1978.** Sari, S.O. (Arizona Univ., Tucson (USA)). Mar 1978. Contract EG-77-S-02-4381. 28p. Dep. NTIS, PC A03/MF A01.

Differential reflectance spectroscopy has been used to study interactions at liquid-solid and air-solid interfaces. The aim is to examine a number of properties of adsorbed solid and molecular interlayers formed at such boundaries. Differential optical techniques have not previously been used to a large degree to investigate details of interfacial properties. However, in conjunction with x-ray and electron analysis these approaches are important for examining both electronic structure and adsorption-adhesion mechanics of surface coverings even if these are only a few atomic diameters in thickness. Such layers are induced in experiments by electronic circuitry devised to add or subtract controlled amounts of adlayer through reactions at electrolyte-solid interfaces. The purpose is to supply new information of a basic nature concerning interfacial properties. This can be important since crystal phases of some materials exist only in thin surface coverings. Thus, a connection of this work may well be important to new thin-layer technology. Moreover, an important relation seems well established to problems in solar energy. It is known, for example, that interfacial layers modify gas evolution at some electrolyte-oxide boundaries and thus their study is closely relevant to improvement of some new fuel production schemes.

51529 **Elastic fields of a dislocation loop near a stress-free surface.** Ohr, S.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Appl. Phys.;* **49**: No. 9, 4953-4955(Sep 1978).

The displacement field around a finite circular edge dislocation loop lying parallel to a stress-free surface has been calculated. The results indicate that when the loop is located close to the free surface the displacement field is extremely asymmetric across the loop plane. This influences the elastic interaction between the loop and point defects. The free-surface effect is significant for loops located within about five times the loop radius from the free surface.

51530 **Monte Carlo study of the Coulomb gas and the Villain XY model in the discrete Gaussian roughening representation.** Swendsen, R.H. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B;* **18**: No. 1, 492-502(1 Jul 1978).

Monte Carlo simulations of the two-dimensional discrete Gaussian model of roughening are used to obtain the thermodynamic properties of the Coulomb lattice gas and the Villain XY model. A comparison of the results with the first four terms in the low-temperature expansion of the discrete Gaussian model and the independent-pair approximation in the Coulomb gas representation confirms the accuracy and reliability of the Monte Carlo method generally, but reveals difficulties in the neighborhood of the transition. Various types of Monte Carlo simulations are compared and their consequences in different representations are discussed.

51531 **ac conductivity of a one-dimensional site-disordered lattice.** Albers, R.C.; Gubernatis, J.E. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., B;* **17**: No. 12, 4487-4494(15 Jun 1978).

We report the results of a numerical study of the ac conductivity for the Anderson model of a one-dimensional, site-disordered system of 400 atoms. For different degrees of disorder, we directly diagonalized the Anderson Hamiltonian, used the Kubo-Greenwood formula to evaluate the conductivity, and then averaged the conductivity over 12 configurations. We found that the dominant frequency dependence of the conductivity consisted of a single peak which shifted to higher frequency and decreased in overall magnitude as the disorder was increased. The joint density of states and the eigenstate localization were also computed and are discussed in connection with our results.

51532 **Short-range correlations in the electron gas.** Bedell, K.; Brown, G.E. (Nordita, Blegdamsvej 17, DK-2100 Copenhagen O, Denmark). *Phys. Rev., B;* **17**: No. 12, 4512-4526(15 Jun 1978).

The effects of short-range correlations on the properties of the electron gas are studied using an approach phrased in the polarization potential language of Pines and Nozieres. It was argued by Lowy and Brown that two-body terms make up the dominant contribution to the effective interaction for large momentum transfers. In the region of small-momentum transfers it is known that the random-phase approximation provides an adequate picture of the electron gas. With these two regions of large- and small-momentum transfers in mind, a polarization propagator is constructed to interpolate between them. A number of sum rules, among them the f-sum rule, involving the imaginary part of the polarization propagator, were found to be satisfied. The failure of our theory to satisfy the compressibility sum rule is discussed in detail. We present here the results for the local t matrix, the dynamic and static form factors, and the pair correlation function. That our pair-correlation function remains positive and is essentially the same as in the paper of Lowy and Brown indicates that the physics and not the formalism is responsible for the results we obtain.

51533 **Unrestricted Hartree-Fock approach to cluster calculations. II. Interaction of cluster and environment.** Kunz, A.B.; Klein, D.L. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Phys. Rev., B;* **17**: No. 12, 4614-4619(15 Jun 1978).

An ab initio approach to determining the appropriate potential in which to embed a cluster in order to simulate a larger system is proposed. For ionic and covalent systems, simple approximations are presented as obtained by systematic simplifications of the more

general theory. It is also seen that for metallic systems such a reduction is not obtained. The results obtained using the current approach for LiF simulated by a Li_6F cluster are contrasted to those obtained using a more conventional Watson-sphere environment and also free-space boundary conditions.

51534 Finite-energy f-sum rules for valence electrons. Smith, D.Y.; Shiles, E. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B;* **17**: No. 12, 4689-4694(15 Jun 1978).

The number of electrons effective in optical processes up to an energy ω, n/sub eff/(ω), may be defined in three distinct ways, a situation which had led to considerable confusion. This is a consequence of the fact that oscillator-strength sums may be extinction coefficient κ (ω), or the energy-loss function Im[ϵ^{-1}(ω)]. Here these quantities are investigated for an electronic system embedded in a polarizable medium of dielectric constant ε/sub b/. This model closely approximates valence electrons moving in the background of polarizable ion cores in a condensed phase. The oscillator-strengh sums are found to differ significantly and are not simply related at energies for which the embedded system's oscillator strength is not exhausted. In the limit in which exhaustion occurs, the sums differ only because of the shielding effects of polarizable medium. The f sums for κ (ω) and Im[ϵ^{-1}(ω)] yield effective "strengths" that are reduced from the oscillator strength by factors of ε/sup -1/2//sub b/ and ϵ^{-2}/sub b/, respectively. Similar results hold for the three definitions of n/sub eff/(ω). The analysis of a system in terms of partial f sums is shown to provide a check on the self-consistency of optical data as well as a means of determining core polarizabilities. These effects are illustrated for metallic aluminum.

51535 Interaction of point defects with dislocations in an external stress field and radiation-induced creep. Saralidze, Z.K. (Institute of Physics, Academy of Sciences of the Georgian SSR, Tbilisi). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 2, 218-221(Feb 1978).

An expression is obtained for the rate of radiation-induced creep resulting from a change in the energy of the interaction between point defects and dislocations in an external stress field. The relative contributions of the distortion of the fields of point defects and dislocations are considered. It is shown that the rate of creep due to the effect in question should be low and, under certain conditions, it may even have a negative sign. It is concluded that the change in the interaction energy is not the only reason for the dependence of the creep rate on the rate of formation of point defects.

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 50674

51536 (COO—2315-11) **Theory of electron—photon scattering effects in metals. Progress report, December 1, 1976—November 30, 1977.** Lawrence, W.E. (Dartmouth Coll., Hanover, N.H. (USA)). 1977. Contract EY-76-S-02-2315. 10p. Dep. NTIS, PC A02/MF A01.

The general areas in which the investigations were carried out are transport properties and quasiparticle lifetimes in normal metals and superconductors. The more specific research projects upon which progress is reported are (a) the calculation of order parameter relaxation times in aluminum, (b) transport coefficients of the noble metals (emphasizing deviations from Matthiessen's rule), (c) variational transport calculations for a superconductor, (d) some general results on quasiparticle relaxation time anisotropy in polyvalent metals, and (e) a clarification of the roles of electron-electron and electron-phonon scattering in somple metals at low temperatures.

51537 (COO—3551-43) **Some calculations of the electron—phonon mass enhancement factor in PdH and PdD using various electron—phonon decoupling approximations. Topical report, April 1, 1977—March 31, 1978.** Brown, J.S. (Vermont Univ., Burlington (USA). Dept. of Physics). 1978. Contract EY-76-S-02-3551. 8p. Dep. NTIS, PC A02/MF A01.

Some calculations are presented of the electron-phonon mass enhancement factor lambda for some transition metal hydrides and deuterides, namely PdH and PdD. The calculation of lambda in the McMillan approach involves the determination of the coupling constant $\alpha^2(\omega)$, which enters through the combination $\alpha^2(\omega)F(\omega)$, where $F(\omega)$ is the phonon spectrum. For PdH(D) solid state theory leads to a very difficult double integral over the Fermi Surface, which is extremely intractable. The use of a number of phenomenological models of $\alpha^2(\omega)$, coupled with the use of a sum rule over the phonon spectrum were studied. Certain of these approximations lead to untenable rsults based on physical considerations, while others merit further study.

THEORETICAL PHYSICS

GENERAL AND MISCELLANEOUS

51538 (ORO—3992-321) **Speed of light as measured by two terrestrial stable clocks.** Hsu, J.P.; Sherry, T.N.; Chiu, C.B. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center; Texas Univ., Austin (USA). Center for Particle Theory). 1977. Contract EY-76-S-05-3992. 14p. Dep. NTIS, PC A02/MF A01.

It is shown that despite the recent criticism within the special theory of relativity there exists an arrangement of stable clocks rotating with the earth which predicts diurnal variations of the one-way speed of light, as suggested previously.

51539 (ORO—3992-322) **Critical comments on "on the constancy of the speed of light".** Hsu, J.P.; Sherry, T.N. (Texas Univ., Austin (USA). Center for Particle Theory; National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). 1977. Contract EY-76-S-05-3992. 13p. Dep. NTIS, PC A02/MF A01.

Criticisms are answered on the new theory of the constancy of the speed of light. All criticisms are answered, and it is shown that the new theory is not logically inconsistent for the reasons expressed. 17 references. (JFP)

CLASSICAL AND QUANTUM MECHANICS

51540 Equivalence of quantum mechanics and a certain class of Markov processes. Davidson, M. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *J. Math. Phys. (N.Y.);* **19**: No. 9, 1975-1978(Sep 1978).

Some new results in the stochastic model of quantum mechanics are derived. The origin of the noncommutative algebra of quantum mechanics is given a simple interpretation within the stochastic model. Quantum expectations of mixed functions of coordinates and momenta are related to stochastic averages.

51541 Comments on quantum systems subject to random pulses. Blume, M. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *J. Math. Phys. (N.Y.);* **19**: No. 9, 2004(Sep 1978).

An error in a recent paper on this subject by Gzyl is corrected. His results are then identical to those obtained earlier by Clauser and Blume.

RELATIVITY AND GRAVITATION

51542 Critical comments on "On the constancy of the velocity of light". Hsu, J.P.; Sherry, T.N. (Space Sciences Laboratory, Marshall Space Flight Center, Huntsville, Alabama.). *Found. Phys.;* **8**: No. 7, 609-614(Jul 1978).

A new theory of four-dimensional symmetry introduced by Hsu has been criticized as logically inconsistent. We answer the criticisms that have been raised and show that in fact this theory is not logically inconsistent.

STATISTICAL PHYSICS AND THERMODYNAMICS

51543 (UCRL-Trans—11373) **Tables of thermodynamic functions of a substance at a high concentration of energy.** Kalitkin, N.N.; Kuz'mina, L.V. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). May 1978. Translation of Preprint No. 35, 1975. 50p. Dep. NTIS, MF A01.

Portions of document are illegible.

Detailed tables of the Thomas-Fermi thermodynamic functions and the quantum and exchange corrections of order h^2 for them have been prepared. They are presented in a form that enables us to use them for any element of the periodic system. The tables cover a wide range of volumes- from highly compressed substance to rarefied gas, and temperatures from zero to tens of kilovolts. A comparison is made of the results with experimental data and calculations from more accurate models; the limits of applicability of the tables are evaluated.

ELECTRICITY AND MAGNETISM

51544 Theory of Dirac magnetic poles. Sokolov, V.V. (Institute of Nuclear Physics, Siberian Division, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 2, 224-227(Aug 1977).

It is discovered why the singularity line arises in the theory of the Dirac monopole. It is shown that this feature is caused by the ambiguous dependence of the azimuthal angle on the space point and

is therefore of purely kinematic origin. Correct consideration of this ambiguity causes the contribution of the string to disappear in both the classical and the quantum equations of motion and in the Poisson brackets. The validity of the Jacobi identity is demonstrated explicitly for the double Poisson brackets of the Cartesian components of the relative velocity.

MATHEMATICAL PHYSICS

51545 (HEDL-TME—77-51) **Generalized least-squares for data analysis.** Schmittroth, F. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1978. Contract EY-76-C-14-2170. 47p. Dep. NTIS, PC A03/MF A01.

A working document is given on the method of generalized least squares. It discusses the assumptions underlying the use of least-squares methods, and summarizes the possible forms of the least-squares equations. Some details needed for practical applications beyond the general formalism are also presented.

51546 Constructive approach to the solution of a class of boundary value problems of mixed type. Kaper, H.G. (Argonne National Lab., IL). *J. Math. Anal. Appl.;* **63**: No. 3, 691-718(May 1978).

The solution of boundary value problems which are described by the linear integrodifferential equation delta xu/delta t(t, x) + u(t,x) - $1/\pi^{1/2}$ infinity $\exp(-y^2)$ u(t,y) dy = 0, where t epsilon J C R, x epsilon R is discussed. The equation in functional form is interpreted as an ordinary differential equation for the mapping u: J → L_2(R, μ), where L_2(R,μ) is a weighted L_2-space. Emphasis is on the constructive aspects of the solution and on finding representations of the relevant isomorphisms.

51547 Survey of several finite difference methods for systems of nonlinear hyperbolic conservation laws. Sod, G.A. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012, and Lawrence Livermore Laboratory, P. O. Box 808, Livermore, California). *J. Comput. Phys.;* **26**: No. 4, 1-31(Apr 1978).

The finite difference methods of Godunov, Hyman, Lax and Wendroff (two-step), MacCormack, Rusanov, the upwind scheme, the hybrid scheme of Harten and Zwas, the antidiffusion method of Boris and Book, the artificial compression method of Harten, and Glimm's method, a random choice method, are discussed. The methods are used to integrate the one-dimensional Eulerian form of the equations of gas dynamics in Cartesian coordinates for an inviscid, nonheat-conducting fluid. The test problem was a typical shock tube problem. The results are compared and demonstrate that Glimm's method has several advantages.

51548 Optics of ion beams of arbitrary perveance extracted from a plasma. Whealton, J.H.; Jaeger, E.F.; Whitson, J.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *J. Comput. Phys.;* **26**: No. 4, 32-41(Apr 1978).

A new iteration scheme is proposed for the solution of the ion optics of high current ion beams extracted from a plasma. The scheme (a) requires far less computational effort than other schemes; (b) converges for arbitrary perveance; (c) allows the solution of the problem far back into the extraction plasma and (d) is not geometry dependent, so it should be usable for a wide variety of situations.

51549 (UCRL-Trans—11384) **Transmission of discrete information by periodic and quasi-periodic channels.** Jacobs, K. Translated from *Math. Ann.;* **137**: 125-136(1959). 3p. Dep. NTIS, PC A02/MF A01.

Chintschin has reported an exact proof of the most important theorems on the transmission of discrete information by noisy channels. This article deals with considerations leading to Shannon's first theorem; Chintschin's results are applied to quasi-periodic (hence, perforce, periodic) sources and channels. The crucial idea is that each quasi-periodic probability distribution is totally continuous with respect to its stationary mean value; McMillan's theorem is true for this; and, if McMillan's theorem is true for a distribution, it is also true for any distribution which is totally continuous with respect to it. Corresponding facts apply to quasi-periodic channels, so the whole theory can be reduced to the stationary case. Presumably, some existence problems associated with the transmission of signals form articifical earth satellites to fixed terrestrial stations are solved by this approach. (RWR)

FUSION ENERGY

51550 Plasma physics index. Thesaurus, 1978. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1978). 22p.

This thesaurus comprises physical and technical terms serving as keywords for classifying literature in the field of plasma physics. The keywords are divided into 4 main groups: "properties", "phenomena, effects and processes", "objects", and "methods". (MOW)

51551 Technology index for plasmaphysics research and fusion reactors. Volume 12, No. 4, 1978. Bibliography, author index, subject index, appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1978). 54p.

This bibliography contains 236 references on various aspects of plasma physics and thermonuclear reactor research. Author and subject indexes are included. (MOW)

51552 Technology index for plasmaphysics research and fusion reactors. Volume 11, No. 9, 1977. Bibliography, author index, sugject index, appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1977). 57p.

This listing contains 250 references on various aspects of plasma physics and controlled fusion research. (MOW)

PLASMA RESEARCH

51553 Development of perturbations when a shell target is compressed by laser radiation. Bokov, N.N.; Bunatyan, A.A.; Lykov, V.A.; Neuvazhaev, V.E.; Strotseva, A.P.; Frolov, V.D. *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 9, 478-481(5 Nov 1977).

A numerical investigation is made of the irradiation asymmetry and of the uneven shell thickness on the degree of compression and shape of the target as functions of the amplitude and wavelength of the perturbations.

PLASMA CONFINEMENT AND HEATING

REFER ALSO TO CITATION(S) 51600

51554 (COO—4020-6) **Study of flow and loss processes at the ends of a linear theta pinch. Progress report, June 1, 1977—May 31, 1978.** York, T.M.; Klevans, E.H. (Pennsylvania State Univ., University Park (USA)). Feb 1978. Contract EY-76-S-02-4020. 201p. Dep. NTIS, PC A10/MF A01.

Experimental and analytical studies of end loss from a theta pinch have been carried out. Detailed diagnostic studies of a 25 cm long theta pinch operating with reversed trapped fields have been completed; spectroscopic studies, magnetic probe, pressure probe, double diamagnetic loop, luminosity studies and Thomson scattering studies of the plasma have been carried out over the 8 μsec duration of the transient loss. Two new diagnostic techniques have been developed based on the available Thomson scattering laser source. A study of plasma loss from a 10.5 long theta pinch with an axial Twyman-Green interferometer has been completed and reported. The basic studies needed for subsequent experimental work on heat conduction loss being diagnosed by Thomson scattering data in the end region, with and without mirror coil, has been completed as a part of the mirror field studies.

51555 (PPPL—1449) **Penetration of slow waves into an overdense plasma.** Motley, R.W.; Bernabei, S.; Hooke, W.M.; McWilliams, R.; Olson, L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jun 1978. Contract EY-76-C-02-3073. 18p. Dep. NTIS, PC A02/MF A01.

Probe measurements are reported of the propagation of a 2.45 GHz slow wave launched into a linear, overdense test plasma by a phased double waveguide. We find that waves in the frequency interval omega/sub LH/ < omega < omega/sub pe/ penetrate to the plasma interior only if they satisfy the accessibility criterion.

51556 (PPPL—1452) **Nonlinear evolution of lower hybrid waves.** Karney, C.F.F.; Sen, A.; Chu, F.Y.F. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jun 1978. Contract EY-76-C-02-3073. 40p. Dep. NTIS, PC A03/MF A01.

The two-dimensional steady-state distribution of lower hybrid waves is governed by the complex modified Korteweg-deVries equation. The equation is studied numerically. Two types of solitary waves can arise. One is a constant phase pulse, whereas the other is an envelope solitary wave. These solitary waves are not solitons. The occurrence of the constant phase pulses points to the possibility of internal reflections due to scattering off ponderomotive density fluctuations. This necessitates solving the equation as a boundary value problem. With typical fields for lower hybrid heating of a tokamak, it is found that large reflections can occur close to the edge of the plasma.

51557 Resolving the positive, negative, and neutral fluxes of an expanding, laser-produced plasma. Sarraf, S.; Woodall, D.M. (Laboratory for Laser Energetics, University of Rochester, Rochester,

New York 14627). *Rev. Sci. Instrum.;* **49**: No. 8, 1147-1150(Aug 1978).

The space-charge separation seen in an expanding, laser-produced plasma is a remnant of energetic electrons produced in anomalous laser absorption. In order to better understand this phenomenon, a Faraday cup collector has been devised which simultaneously records positive, negative, and neutral components of such an expanding plasma. The response of this detector to a laser-produced plasma is measured and compared to magnetically filtered ion collectors. This detector proves superior to the magnetic collector for energetic ions, but is limited to low plasma densities by collective effects.

51558 Direct measurement of plasma space potential on Elmo bumpy torus. Colestock, P.L.; Connor, K.A.; Hickok, R.L.; Dandl, R.A. (Department of Electrical and Systems Engineering, Rensselaer Polytechnic Institute, Troy, New York 12181). *Phys. Rev. Lett.;* **40**: No. 26, 1717-1720(26 Jun 1978).

A heavy-ion—beam probe has been used to measure the space-potential distribution on the Elmo bumpy torus. The results indicate that under optimum confinement conditions the ambipolar electric field is nearly axisymmetric, points radially inward, and is of sufficient magnitude to dominate the ion poloidal drifts.

51559 Plasma edge cooling during rf heating. Suckewer, S.; Hawryluk, R.J. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). *Phys. Rev. Lett.;* **40**: No. 25, 1649-1651(19 Jun 1978).

A new approach to prevent the influx of high-Z impurities into the core of a tokamak discharge by using rf power to modify the edge plasma temperature profile is discussed. This concept is based on spectroscopic measurements on PLT (Princeton Large Torus) during ohmic heating and ATC (Adiabatic Toroidal Compressor) during rf heating.

51560 Maximum expansion velocities of laser-produced plasmas. Pearlman, J.S.; Morse, R.L. (Division of Laser Fusion, U. S. Energy Research and Development Administration, Washington, D. C. 20545). *Phys. Rev. Lett.;* **40**: No. 25, 1652-1655(19 Jun 1978).

Comparisons of observed ion velocity maxima with predictions of theoretical models suggest that departures from ideal isothermal expansion behavior are caused by nonequilibrium critical-surface electron distributions.

51561 Study on high-frequency breakdown at 0.8-0.9 ghz. Ohkubo, K.; Matsuura, K. (Nagoya Univ, Jpn). *Jpn. J. Appl. Phys.;* **17**: No. 1, 117-123(Jan 1978).

Experiments are reported on the rf breakdown in two resonators of a re-entrant type and a partially concave waveguide along the axis in the frequency range of 0.8-0.9 GHz, with emphasis on LHRH in tokamak plasma. The characteristics of the breakdown are significantly dependent on the uniformity of the rf field as well as the prsence of initial electrons, but independent of the filling pressure of hydrogen gas below $10^{-}\gamma$ Torr. The mechanism of breakdown is mainly reduced to that of the secondary electron resonance breakdown. 6 refs.

51562 "Magnetic projectile" as carrier of magnetic flux for excitation of longitudinal current in a plasma loop. Kirko, A.I.M.; Kirko, G.E. (Department of Polymer Physics, Ural Scientific Center, Academy of Sciences of the USSR, Perm'). *Sov. Phys. - Dokl. (Engl. Transl.);* **22**: No. 12, 767-768(Dec 1977).

By considering the energy balance equation, it is shown that the proper arrangement of solenoids can produce a "freezing in" of the magnetic field in a toroidal plasma.(AIP)

51563 Linear and nonlinear interactions of microwave radiation near the electron cyclotron frequency in plasmas. Namking, W. Knoxville, TN; Univ. of Tennessee (1977). 120p. University Microfilms Order No. 78-07,712.

Thesis (Ph. D.).

The interactions of microwave near the electron cyclotron frequency with plasmas are investigated by linear wave-particle and nonlinear wave-wave interaction theories for tokamaks and the Elmo Bumpy Torus (EBT). The radial energy distribution of electron cyclotron heating in tokamaks is considered. The fine structure of cyclotron resonance is investigated from damping of electromagnetic waves. The spatial shape factor is obtained from a general heating model in tokamaks, which removes singularities at the magnetic axis and the tangency point of the mod-B surface. The ORNL 1-D Transport Code is used to find the temporal and spatial behaviors of plasma parameters with electron cyclotron heating on the ISX tokamak. The profile modification will depend on the response of impurities to heating. A new ω-contour method for dispersion relation of electrostatic waves is introduced in order to find threshold values of parametric decay instabilities near the upper hybrid frequency.

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 51599, 51600

51564 (IPPT-IFTR—85/1976) Electromagnetic inverse problem of inhomogeneous anisotropic plasma diagnostics. Zuchowski, K. (Polska Akademia Nauk, Warsaw. Instytut Podstawowych Problemow Techniki). 1976. 14p. (In Polish). Dep. NTIS (US Sales Only), PC A02/MF A01.

Inverse problem for hyperbolic equations system of first order describing propagation of electromagnetic waves in inhomogeneous anisotropic plasma is solved.

51565 (UCRL—80902) Real-time interferometer phase detection using an LSI-11 microcomputer and high-speed digital techniques. Mendell, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Mar 1978. Contract W-7405-ENG-48. 13p. (CONF-780621—2). Dep. NTIS, PC A02/MF A01.

From NBS-IEEE microcomputer based instrumentation conference; Gaithersburg, MD, USA (12 Jun 1978).

This paper describes the basic design and philosophy of a real-time, interferometer phase-detection system used on the 2XIIB and TMX magnetic-fusion experiments at the Lawrence Livermore Laboratory. This diagnostics system is now a satellite to a host computer and uses high-speed, emitter-coupled logic techniques to derive data on real-time phase relationships. The system's input signals can be derived from interferometer outputs over a wide range of reference frequencies. An LSI-11 microcomputer is the interface between the high-speed phase-detection logic, buffer memory, human interaction, and host computer. Phase data on a storage CRT is immediately displayed after each experimental fusion shot. An operator can interrogate this phase data more closely from an interactive control panel, while the host computer is simultaneously examining the system's buffer memory or arming the system for the next shot.

51566 (UCRL—80933) Effect of plasma shielding on the fidelity of magnetic probe in a plasma focus environment. Zucker, O.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Apr 1978. Contract W-7405-ENG-48. 22p. (CONF-780552—1). Dep. NTIS, PC A02/MF A01.

From Conference on plasma science; Monterey, CA, USA (15 May 1978).

This paper examines the fidelity of a dielectric, encapsulated magnetic probe in the adverse plasma environment encountered in plasma focus experiments. The ionization of the surface of the probe produces a conductive layer that tends to shield it from external magnetic fields. The solution of the wave equation is used to show the allowed regions of conductivity, sigma, and thickness, d, for the ionized layer. The results show that as d approaches the penetration depth, delta = ($\omega\mu$sigma)/sup $^1/_2$/, severe attenuation and distortion results, rendering the probe useless. When d is much less than delta, we encounter attenuation only, which also may be too severe for use. Finally, an experiment is described, which allows the experimenter to determine the fidelity of the probe.

51567 Multidipole plasma density. Lang, A.; Hershkowitz, N. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). *J. Appl. Phys.;* **49**: No. 9, 4707-4710(Sep 1978).

The primary-electron bias voltage and the neutral-pressure dependence of plasma density in a multidipole device are investigated. Experimental data are described by a simple model which takes into account the production of multiple electron-ion pairs by each ionizing primary electron.

51568 Flat-response, subkiloelectronvolt x-ray detector with a subnanosecond time response. Kornblum, H.N.; Slivinsky, V.W. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Rev. Sci. Instrum.;* **49**: No. 8, 1204-1205(Aug 1978).

A detector that has a flat response to x rays with energies between 100 eV and 1.5 keV has been built. It has been used to measure x rays emitted from gold disks irradiated by the Argus laser at Lawrence Livermore Laboratory. Results from this detector are in good agreement with results from other techniques.

51569 Thomson scattering measurements of plasma turbulence near quarter-critical density in a CO_2 laser-heated gas target plasma. Schuss, J.J. Princeton, NJ; Princeton Univ. (1978). 145p. University Microfilms Order No. 78-07,497.

Thesis (Ph. D.).

Plasma turbulence at and below quarter critical density in a CO_2 laser-heated gas target plasma is experimentally investigated using ruby laser Thomson scattering. In addition to yielding data on plasma density and temperature this diagnostic reveals a strongly nonthermal level of plasma turbulence at one half the CO_2 laser frequency, which is attributed to the parametric decay of the CO_2

laser light into plasma waves. The theory of laser driven parametric instabilities relevant to this experiment is reviewed, with particular attention paid to the two plasmon parametric decay. It is theoretically demonstrated that the threshold condition for this decay can be relaxed if the pump wave is obliquely incident on the density gradient. Thomson scattering theory relevant to this experiment is then summarized and the effect of temporal and spatial variations in the plasma density is calculated. The Thomson scattering equipment constructed to study the target plasma is described, including a novel multichannel spectrometer employing low loss optical fibers and one photomultiplier tube. Large angle Thomson scattering results obtained from the CO_2 laser-heated gas target plasma are presented, which yield n/sub e/(t) and T/sub e/(t) curves.

51570 **Laser scattering with a rapidly tuned dye laser.** Kopainsky, J. (Technische Universitaet, Munich). *Appl. Phys.;* **9**: 229-239(Nov 1975).

A facility is described for the measurement of the total spectrum produced by laser radiation scattered from a plasma during one laser pulse. The dye laser is electrooptically tuned by a high frequency voltage applied to a modified Lyot filter within its cavity. The scattered spectrum is recorded together with the laser reference signal by a transient recorder and processed afterwards. Scattering experiments have been accomplished in a H_2 cascade of 5 mm diameter arc at atmospheric pressure, and at 14 and 20 A, respectively. For this arc very precise spectroscopic results are available for checking the accuracy of the scattering measurements. Both the spectroscopic line and continuum experiments yield a temperature which lies between electron and ion temperature if there is no local thermal equilibrium, whereas the pure electron temperature is provided by the scattered spectrum. The agreement between spectroscopic and scattering results within the high error limits is good.

PLASMA KINETICS - GENERAL

REFER ALSO TO CITATION(S) 51345

51571 (Juel—1448) **Origin of impurities in hydrogen plasmas.** Dietz, K.J.; Waelbroeck, F.; Wienhold, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-KFA, Juelich (Germany, F.R.)). Aug 1977. 28p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Prehandling and discharge cleaning methods applied in toroidal magnetic systems with metallic walls have been surveyed and their efficiency in depressing the initial concentration of low Z contaminants (mainly oxygen, but also carbon) have been compared. Chemical reactions between atomic (H^0 and H^+) hydrogen species and chemically bound oxygen and lattice-bound carbon in the surface-near layers are found to play a dominant role in the impurity release. Discharge cleaning in Tokamaks tends to crack and ionize the resulting water and hydrocarbons, leading to impurity ions which recombine chemically with the walls at the end of the discharge cycle. An ultrahigh vacuum apparatus has been built, in which the cleaning efficiency of H^0 and H^+ is investigated. The flux densities of the atomic species have been varied between 10^{14} and 5 x 10^{16} atoms/cm^2s, covering the range of the averaged values of present day confinement devices and future reactors. The cleaning efficiency is found to be high. A chemical kinetics model describes the mechanisms involved. An H_2 blistering-like effect is observed and is attributed to the H + H recombination underneath the surface. This process influences the recycling phenomena and probably also accounts for the early appearance of metallic impurities in tokamak experiments. Conclusions to be shown from our measurements concerning phenomena observed in confinement systems are presented.

PLASMA KINETICS - EXPERIMENTAL

51572 (INIS-mf—4202) **Plasma physics group progress report for 1976.** (Australian National Univ., Canberra. Dept. of Engineering Physics). 1977. 32p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Progress is reported on the continuing experimental programme on the Lt-3 tokamak, the completion of the new LT-4 tokamak and newly developed diagnostic techniques. Experimental work on LT-3 was generally aimed at invest-igating aspects of the disruptive instability. Magnetic probe measurements were made to obtain radial profiles of the toroidal electric field and an electrostatic probe was used to identify high frequency fluctuations in the plasma at the time of the disruption. Further measurements were also made of local variations in the poloidal magnetic field due to the development of tearing MHD modes. Some preliminary work was done in an investigation of the development of the plasma current profile as operating parameters were varied. During the initial operation of LT-4 (I) diagnostics were limited to standard electrical measurements, spectroscopic and magnetic field observations. Thomson scattering measurements are included in the longer term programme and a ruby laser system has been ordered. New diagnostic techniques used with LT-3 include a variation of the swept Langmuir probe and a method for abelisation of spectroscopic observations in toroidal geometry.

51573 (PGPP—77-2) **Spectroscopic observation of LT-3 tokamak plasma at disruptive instability.** Morton, A.H.; Srinivasacharya, K.G. (Australian National Univ., Canberra. Research School of Physical Sciences). Oct 1977. 16p.p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Chord observations of radiation from oxygen impurity ions (OIII, OIV and OV) in the LT-3 hydrogen plasma have been made simultaneously through a number of optical ports. These showed a spacially structured entry of oxygen into the plasma just prior to the disruption and, at the disruption, an expansion of the central plasma into the outer regions with velocities of 3 - 8 km s^{-1}. The plasma column appeared to be kinked with a stationary modal structure of m = n = 1 on which were superimposed a moving central M = 1 perturbation and at larger radii moving perturbations with m > 1.

51574 **In this issue.** *Eng., Cornell Q.;* **12**: No. 3, 1(Dec 1977).

The following topics are discussed in this issue: (1) review of a decade of research in plasma studies at Cornell, (2) reaching ignition temperature in a controlled thermonuclear reactor, (3) heating toroidal plasmas with electron beams, (4) new sources of very high power, and (5) an ion ring bottle for a fusion reactor. (MOW)

51575 **Experimental study of the Texas turbulent torus.** Stinnett, R.W. Austin, TX; Univ. of Texas (1977). 204p. University Microfilms Order No. 78-07,390.

Thesis (Ph. D.).

Both the preheat and turbulent phase plasmas produced in the Texas Turbulent Torus discharge have been studied using microwave interferometry, Langmuir probe scans, Thompson scattering, microwave radiation detection, and an E vector x B vector velocity analyzer to obtain a picture of the evolution of the plasma during both phases of the discharge. A cool, uniform, well understood preheat plasma is produced which is subjected to a large toroidal electric field during the turbulent phase. The electron velocity distribution is measured during turbulent heating using an E vector x B vector velocity analyzer. A turbulent skin arises on the plasma edge which penetrates into the higher density ($> 3 \times 10^{12} cm^{-3}$), interior portion of the plasma on a microsecond time scale. Large drift velocities (v/sub d/ > v/sub Th/) and non-Maxwellian temperatures of several KeV are characteristic of the turbulent plasma. During the turbulent phase of the discharge large heating rates (12KeV/μs) are observed together with rapid energy losses from the edge of the plasma and less rapid losses from the interior. The non-Maxwellian velocity distributions provide an explanation for observed inconsistencies between laser, x-ray, and magnetic probe measurements while showing agreement with each measurement individually.

51576 **Stark broadening of neutral helium lines in a plasma.** Kelleher, D.E. College Park, MD; Univ. of Maryland (1977). 157p. University Microfilms Order No. 78-08,193.

Thesis (Ph. D.).

Side-on observations of the visible spectrum emitted by a helium plasma generated in a wall-stabilized arc are reported. Electron densities range from 0.2 to 1.3 x 10^{16} cm^{-3} and electron temperatures vary from 10,000 to 20,000 K. The widths and shifts of all but one of the seventeen measured neutral helium lines are predominantly determined by Stark effects caused by the electric field of the charged particles in the plasma.

PLASMA KINETICS - THEORETICAL

51577 (ANL/FPP—77-7, pp 49-54) **Applied plasma physics.** 1977.

In Fusion Power Program. Quarterly progress report, October—December 1977.

The following two areas of research are discussed: (1) disparate clump approximation in neoclassical transport theory, and (2) spectroscopic data for Cu-like ions. (MOW)

51578 (IPPT-IFTR—83/1976) **Generalization of Langevin equation, autocorrelations and plasma resistivity.** Brahmer-Kacprzynska, A.; Zielke, W. (Polska Akademia Nauk, Warsaw. Instytut Podstawowych Problemow Techniki). 1976. 21p. (In Polish). Dep. NTIS (US Sales Only), PC A03/MF A01.

Correctness of fluctuous-dissipative theorems obtained for plasma, assuming known values of electric field autocorrelations, is studied. Plasma resistivity is calculated.

51579 (JAERI-M—7196) **Evaluation of radiation cross sections of K x-rays and application to measurement of metal impurity densities in high-temperature plasma.** Matoba, T.; Kumagai, K.; Funahashi, A.; Kawakami, T. (Japan Atomic Energy Research Inst., Tokyo). Jul

1977. 20p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

The radiation cross sections (* sub(K)) of K X-rays from metal impurities by electron impact in high temperature plasmas were calculated in atomic numbers of 6 to 82 by three different methods. The cross sections calculated by relativistic theory (A and M theory) are in good agreement with the experimental ones at electron energies below 500 keV. Electron-temperature dependency of the K X-ray emission rate (<* sub(K)v>) was estimated from the cross sections. Densities of the metal impurities can be obtained experimentally from the absolute soft X-ray spectrum measured with a semiconductor detector, electron temperature and electron density, using the calculated K X-ray emission rate.

51580 (JEN—398) **Shape of the Hα emission line in non resonant charge exchange in hydrogen plasmas.** Susino Bueno, A.; Zurro Hernandez, B. (Junta de Energia Nuclear, Madrid (Spain)). 1977. 81p. (In Spanish). Dep. NTIS (US Sales Only), PC A05/MF A01.

The Hα line shape emitted from a maxwellian hydrogen plasma and produced by non resonant change exchange has been calculated. Its explicit shape depends on the ion temperature, on background neutral energy and on the relative shape of the collision cross section. A comparison between theoretical and experimental shapes of the Hα line is carried out to check the model and to deduce the ion plasma temperature.

51581 (NRCN—438) **Two dimensional plasma simulation code.** Hazak, G.; Boneh, Y.; Goshen, Sh.; Oreg, J. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Mar 1977. 36p. Dep. NTIS (US Sales Only), PC A03/MF A01.

An electrostatic two-dimensional particle code for plasma simulation is described. Boundary conditions which take into account the finiteness of the system are presented. An analytic solution for the case of crossed fields plasma acceleration is derived. This solution serves as a check on a computer test run.

51582 (PPPL—1437) **Fokker—Planck/transport analyses of fusion plasmas in contemporary beam-driven tokamaks.** Mirin, A.A.; McCoy, M.G.; Killeen, J.; Rensink, M.E.; Shumaker, D.E.; Jassby, D.L.; Post, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Princeton Univ., N.J. (USA). Plasma Physics Lab.). Apr 1978. Contract EY-76-C-02-3073. 9p. (CONF-780702—1). Dep. NTIS, PC A02/MF A01.

From Symposium on heating in toroidal plasmas; Grenoble, France (3 Jul 1978).

The properties of deuterium plasmas in experimental tokamaks heated and fueled by intense neutral-beam injection are evaluated with a Fokker-Planck/radial transport code coupled with a Monte Carlo neutrals treatment. Illustrative results are presented for the Poloidal Divertor Experiment at PPPL as a function of beam power and plasma recycling coefficient, R/sub c/. When P/sub beam/ = 8 MW at E/sub b/ = 60 keV, and R/sub c/ = 0.2, then <n/sub hot//n/sub e/> approximately 0.5, [⅔ <anti E/sub ion/>] = 22 keV approximately 6<T/sub e/>, and the D-D neutron intensity is 10^{16} n/sec.

51583 **NEUGG: A transport code for hydrogen atoms in cylindrical hydrogenic plasmas.** Burrell, K.H. (General Atomic Company, San Diego, California 92138). *J. Comput. Phys.;* **26**: No. 4, 88-102(Apr 1978).

A special code describing transport of neutral hydrogen atoms in a hydrogenic plasma has been written. Test comparisons with solutions based on a neutron transport code show that the accuracy is good and the execution time is improved by a factor of six. The code accepts arbitrary, smooth electron and ion density and temperature profiles. Maximum temperatures permitted for accurate results are about 5 keV.

51584 **Effect of non-Boltzmann population of vibrationally excited states on the carbon reduction in a nonequilibrium plasma.** Rusanov, V.D.; Fridman, A.A.; Sholin, G.V. (I. V. Kurchatov Nuclear Energy Institute, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **22**: No. 12, 757-759(Dec 1977).

The reaction rate for the reduction of CO in a nonequilibrium plasma is calculated by allowing for the vibrational spectra of the CO molecules. Relaxation processes are also considered.(AIP)

51585 **Effect of electron dragging by photons in a laser plasma.** Pashinin, P.P.; Prokhorov, A.M. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 10, 526-528(20 Nov 1977).

The dragging of a charge by light in a fully ionized plasma is considered. It is shown that in a laser plasma the drag current and the photo-emf can reach appreciable values.

51586 **Localization of thermonuclear combustion in a plasma with electronic thermal conductivity.** Zmitrenko, N.V.; Kurdyumov, S.P.; Mikhailov, A.P.; Samarskii, A.A. (Institute of Applied Mathematics, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 9, 469-472(5 Nov 1977).

It is shown that within the framework of planar geometry, the process of ignition of thermonuclear combustion in a D+T plasma, when account is taken of the electronic thermal conductivity and of the local absorption of the α particles, can be accompanied by localization of the combustion on definite sections of the medium during a finite time interval. The dimensions and amplitudes of the initial temperature perturbations that lead to resonant excitation of the combustion are indicated. The dimension and time scales of the development of the thermonuclear combustion structure are given.

PLASMA PRODUCTION

51587 **Generation of thermonuclear neutrons by laser action on a conical target.** Vovchenko, V.I.; Goncharov, A.S.; Kas'yanov, Y.S.; Kozlov, O.V.; Krasyuk, I.K.; Malyutin, A.A.; Pastukhov, M.G.; Pashinin, P.P.; Prokhorov, A.M. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 9, 476-477(5 Nov 1977).

A yield of 3 x 10^4 neutrons from a conical target filled with deuterium was observed following the action of laser radiation of intensity 10^{11} W/cm².

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 51573

51588 (IPPJ—287) **Magnetohydrodynamic instabilities in a stellarator.** Matsuoka, K.; Miyamoto, K.; Ohasa, K.; Wakatani, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1977. 19p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Numerical studies of stability on kink and resistive tearing modes in a linear stellarator are presented for various current profiles and helical fields. In the case of an l = 2 helical field, a magnetic shear vanishes and the stability diagram is given by the straight lines with iota sup(*) + iota sup(delta) = const., where iota sup(*) is a rotational transform due to the plasma current and iota sup(delta) is due to the helical field. In the l = 2 stellarator with chi sup(delta) > 0.5, the m.h.d. stability against kink and tearing modes is improved compared with that in tokamaks. While an l = 3 helical component exists, the magnetic shear plays an important role in the stability properties. The stability diagrams become fairly complex; however, they can be explained by properties of the Euler equation. It should be noted that the internal kink modes become more unstable than in tokamaks by the l = 3 helical field.

51589 (JAERI-M—7126) **Formalization for optimal feedback control of plasma current and position in a tokamak.** Ogata, A.; Ninomiya, H.; Suzuki, Y. (Japan Atomic Energy Research Inst., Tokyo). Jun 1977. 29p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Simultaneous control of the plasma current and position in a tokamak is formalized to apply an optimal feedback rule. The optimal feedback rule is first explained. A physical model of the tokamak system is then modified to be combined with the feedback rule: A linearized state description is derived from circuit equations of plasma, air-core transformer coil and vertical field coil, with equilibrium equation. Possible extension of the method to a more complicated system is also described.

51590 (ORNL/TM—6213) **Mechanism for major disruptions in tokamaks.** Waddell, B.V.; Carreras, B.; Hicks, H.R.; Holmes, J.A.; Lee, D.K. (Oak Ridge National Lab., Tenn. (USA)). Jun 1978. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

A mechanism is proposed for the major disruption in tokamaks that involves the nonlinear destabilization of odd m tearing modes by the m = 2/n = 1 tearing mode, where m and n denote the poloidal and toroidal mode numbers, respectively. The magnetic islands generated can extend across the plasma cross section. For resistivities of the order of magnitude of those in TOSCA and LT-3, the time scale for their appearance is consistent with the time for the major disruption.

51591 **Effect of magnetic shear on dissipative drift-wave instabilities.** Guzdar, P.N.; Chen, L.; Kaw, P.K.; Oberman, C. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). *Phys. Rev. Lett.;* **40**: No. 24, 1566-1570(12 Jun 1978).

We report the results of a linear radial-eigenmode analysis of dissipative drift waves in a plasma with magnetic shear and spatially varying density gradient. The results of the analysis are shown to be consistent with a recent experiment concerned with dissipative drift-wave instabilities in a toroidal stellarator.

51592 **Current-shear stabilization of the tearing mode instability: a numerical simulation.** Barker, R.J. Stanford, CA; Stanford Univ. (1978). 104p. University Microfilms Order No. 78-08,760.

Thesis (Ph. D.).

A fully-relativistic stream superposition model is employed to conduct a linear, one-dimensional, numerical simulation of a self-consistently confined sheet of plasma whose current density vector is sheared. The plasma is assumed to be collisionless and electrically neutral but otherwise no a priori restrictions are imposed. The simulation is reduced to a one-dimensional problem through Fourier analysis in the two homogeneous dimensions of the equilibrium sheet.

51593 Decay processes in an inhomogeneous time-varying plasma. Andreev, A.A.; Fedorov, V.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **3**: No. 12, 558-559(Dec 1977).

The decay of a homogeneous pump field in an inhomogeneous time-varying plasma into a plasma wave and an ion-acoustic wave is considered theoretically.

51594 Unusually stable hot electron ring in a hot electron plasma confined in a magnetic mirror. Saylors, M.L. Knoxville, TN; Univ. of Tennessee (1977). 97p. University Microfilms Order No. 78-07,721.

Thesis (Ph. D.).

A ring of highly energetic electrons formed in close proximity to conducting walls in a simple magnetic mirror has been observed. The ring is stable at pressures below the Guest-Harris criterion and in the absence of line tying to the end walls. The ring is observed to be stable only when it is formed in close proximity to conducting side walls. A series of experiments in which the ring was forced away from the wall is described. In each case the ring became grossly unstable. Two stabilizing mechanisms in which image charges and currents play a dominant role are suggested.

51595 Non-linear numerical studies of the tearing mode. Schnak, D.D. Jr. Davis, CA; Univ. of California (1977). 232p. University Microfilms Order No. 78-09,254.

Thesis (Ph. D.).

A non-linear, time dependent, hydromagnetic model is developed and applied to the tearing mode, one of a class of instabilities which can occur in a magnetically confined plasma when the constraint of infinite conductivity is relaxed. The model is based on the eight partial differential equations of resistive magnetohydrodynamics (MHD). The equations are expressed as a set of conservation laws which conserves magnetic flux, momentum, mass, and total energy. These equations are then written in general, orthogonal, curvilinear coordinates in two space dimensions, so that the model can readily be applied to a variety of geometries. No assumption about the ordering of terms is made. The resulting equations are then solved by the method of finite differences on an Eulerian mesh. We develop spatial finite difference techniques which guarantee the simultaneous conservation of the desired physical quantities throughout the course of the calculation. Conservative boundary conditions on thermodynamic quantities at a conducting boundary are derived, and special algorithms are developed for advancing the solution at a singular boundary. For the temporal differencing, we use the Alternating Direction Implicit (ADI) method, which avoids the computational difficulties inherent in explicit techniques.

51596 Parametric dependence of ion cyclotron instabilities driven by neutral beam injection. Brecht, S.H. Austin, TX; Univ. of Texas (1977). 113p. University Microfilms Order No. 78-07,269.

Thesis (Ph. D.).

Using kinetic theory, the stability of the ion cyclotron wave and its harmonics are examined in the fast and slow wave limits. This is done by calculating the energy transfer from the ion beam with a transient Coulomb collisional distribution function to the wave and the subsequent damping of the wave by the background species. Critical density ratios and growth rates are obtained from these calculations and used to determine the susceptibility of the wave to destabilization as a function of injection energy, angle of injection and basic plasma parameters.

51597 (ORNL-tr—4604) **Electromagnetic instabilities in a non-collisional plasma.** Laval, G.; Pellat, R.; Vuillemin, M. 1965. Translated by S.D. Blalock Jr. from pp 259-277 of Plasma physics and controlled nuclear fusion research, Vol. 2, International Atomic Energy Agency, Vienna, 1966. (CONF-650935—30). 20p. Dep. NTIS, PC A02/MF A01.

From 2. IAEA conference on plasma physics and controlled nuclear fusion research; Culham, UK (6 Sep 1965).

The authors study the stability of inhomogeneous and collisionless plasmas with respect to electromagnetic perturbations. The macroscopic equilibrium parameters depend only on one coordinate of an orthogonal system, the current carried by the plasma being directed along another coordinate axis. The perturbations considered are constant along the current lines. In plane geometry, for example, the particle distribution depends only on the energy and on the moment of the Hamiltonian of a particle moving along the z axis. The equilibrium is inhomogeneous in the x direction and the deformations are constant along the z axis, the direction of the currents. The authors construct a Lyapunov function whose minimization enables one to obtain all the states of marginal stability and a sufficient condition for stability. In this way they demonstrate the results proposed in the literature on the arguments of marginal modes of neighboring equilibria. They also calculate the growth rate of the instabilities. For theta pinches with inverse field they find a growth rate of the order of [v/sub e/(th)/lambda](a/sub e// lambda)/sup 3/2/, where lambda is the scale of the plasma density gradient, and v/sub e/(th) and a/sub e/ are the thermal velocity and Larmor radius of the electrons. The result is in better agreement with the experimental observations than the resistive theory of Furth, Killeen and Rosenbluth. The growth rate of the instabilities of the hard-core pinch is of the order of [v/sub i/(th)/lambda](m/sub e//βm/sub i/)/sup $^1/_2$/(a/sub i/lambda)^2, where m/sub e/ and m/sub i/ are the electron and ion masses, and β has its usual significance. For the MEST and EPPE experiments at Fontenay-aux-Roses, this growth rate is much slower than that of the resistive tearing modes.

PLASMA WAVE PHENOMENA

51598 (COO—4631-1) **Experimental test of resonant absorption theory. Progress report, January 1, 1978—March 31, 1978.** Yablonovitch, E. (Harvard Univ., Cambridge, Mass. (USA)). Apr 1978. Contract ED-78-S-02-4631. 3p. Dep. NTIS, PC A02/MF A01.

The initial progress in studying the interaction of an ultrashort CO_2 laser pulse with an overdense shock front is reported.

51599 (INIS-mf—4201) **Wills Plasma Physics Department thirty-fourth 6-monthly progress report, July 1 to Dec 31, 1977.** (Sydney Univ. (Australia). School of Physics). 1978. 6p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Progress is reported on research programs which are proceeding in the following topics: plasma sources, hydromagnetic shock waves, rotating plasma, magnetohydrodynamics, laser diagnostics and far infrared interferometry.

51600 Detection of lower hybrid waves within a plasma by microwave scattering. Motley, R.W.; Paoloni, F.J.; Bernabei, S.; Hooke, W.M. (Plasma Physics Laboratory, Princeton University Princeton, New Jersey 08540). *Rev. Sci. Instrum.;* **49**: No. 8, 1143-1146(Aug 1978).

The spatial distribution and intensity of electrostatic waves injected into a hot plasma may be inferred from the scattering of millimeter microwaves. We report measurements on the 30° scattering of 8.6-mm microwaves by a 500-W, 2.45-GHz slow wave excited in a linear plasma by a phased array of two waveguides. From the magnitude of the scattered signal and auxiliary measurements with probes, we infer that a large fraction of the injected power penetrates to the center of the overdense test plasma.

51601 Hybrid simulations of quasineutral pheonmena in magnetized plasma. Byers, J. A.; Cohen, B. I.; Condit, W. C.; Hanson, J. D. (Univ. of California, Livermore). J. Comput. Phys.; **27**: No. 3, 363-369 (Jun 1978).

Presented is a new class of numerical algorithms for computer simulation of low frequency (ωvery-much-less-thanω/sub pe/, ω/sub ce/) electromagnetic and electrostatic phenomena in magnetized plasma. Maxwell's equations are solved in the limits of negligible transverse displacement current (Darwin's model) and quasineutrality. The numerical models treat electrons as a massless fluid and ions as particles. The numerical stability of the algorithms is investigated analytically and verified by computer experiments. The numerical algorithms, in both linearized and fully nonlinear forms, are successfully applied to the study of linear microinstabilities and the efficiency of injected small amplitude currents in causing the local reduction of the external magnetic field in magnetically confined plasmas.

51602 Strong shock waves in a nonideal plasma. Protasov, Y.S. (N. E. Bauman Moscow Higher Technical School). *High Temp. (USSR) (Engl. Transl.);* **15**: No. 5, 792-797(Mar 1978).

The physical characteristics of the shock waves produced in the plasma focus zone of an erosion-type magnetoplasma compressor and a method for obtaining a plane stable shock wave in strongly nonideal plasmas with different chemical compositions are discussed. It is shown that when the plasma from the plasma focus zone is collected in a small-diameter tube a plane, stable explosion wave may be formed which is current-free, and that the transfer of energy from the storage unit to the shock wave is highly efficient.

51603 Collisionless relaxation of a plasma with an unstable electron distribution function. Bakai, A.S.; Sigov, Y.S. (Institute of Applied Mathematics, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **22**: No. 12, 734-736(Dec 1977).

A modified "clouds in a cell" method is used to study the collisionless relaxation of a diffuse electron beam. quasilinear processes are discussed.(AIP)

51604 Spectrum of stimulated Raman scattering in an inhomogeneous plasma. Gorbunov, L.M.; Ramazashvili, R.R. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **22**: No. 12, 1517-1518(Dec 1977).

The change in wave intensity due to Raman scattering is calculated as a function of the incident intensity.

51605 Effect of quasilinear effects on the propagation and damping of lower-hybrid waves in a plasma. Parail, V.V. (I. V. Kurchatov Institute of Atomic Energy). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 10, 528-531(20 Nov 1977).

The quasilinear mechanism of "trapping" of the lower-hybrid waves on the periphery of a plasma is considered.

51606 Coherent non-linear interaction of waves in plasmas. Weiland, J.; Wilhelmsson, H. New York; Pergamon Press (1977). 366p. $27.50.

The following chapters are included: (1) simple nonlinear examples, (2) coupled mode theory, (3) field energy in dissipative media, (4) formulation of nonlinear wave equations in terms of nonlinear current, (5) three-wave interactions, (6) energy relations, (7) negative energy waves, (8) coupled-mode equations, (9) stability criteria and asymptotic behavior for a general system of three interacting waves, (10) explosively unstable cases, (11) linear damping coefficients, (12) electromagnetic and plasma wave interactions, (13) stabilization of explosive instabilities, (14) third-order nonlinear effects, (15) coupling factors for three explosively unstable waves in a beam-plasma system, (16) second order dissipative effects, (17) interaction between waves with finite spread in wave vectors, (18) nonlinear excitation of collective waves, (19) parametric excitation of hybrid resonances, (20) nonresonant wave-wave interaction and wave-partial effects, (21) nonlinear effects, and (22) nonlinear plasma research developments. (MOW)

51607 Electrostatic bounce modes in mirror plasmas. Sharp, W.M. Davis, CA; Univ. of California (1977). 119p. University Microfilms Order No. 78-09,256.

Thesis (Ph. D.).

Electrostatic bounce modes are standing waves that occur in a mirror plasma when the relative spread in electron bounce frequencies is small. The modes can be destabilized by an ion distribution with a peaked perpendicular energy, and experimental data suggest that this mechanism was the principal cause of instability in certain low-density mirror experiments. After a review of theoretical work on electrostatic waves in mirror plasmas, a general matrix eigenvalue equation for the wave potential is derived which accounts accurately for electron histories and which includes the ion response. A computer program for calculating the plasma eigenmodes and the associated threshold densities for instability and maximum growth rates is then described. The threshold densities for unstable bounce modes expected in the Baseball I and Baseball II devices are compared with experimental values. The good agreement between theoretical and experimental thresholds in Baseball II makes bounce modes the most likely cause of instabilities in that device. In Baseball I, the most unstable modes expected from the theory have threshold densities consistently below observed values.

51608 Theory of inhomogeneous self-focusing and pulse reflection in a relativistic plasma. Shockley, R.C. Los Angeles; Univ. of Southern California (1977). vp. Micrographics Dept., Doheny Library, USC, Los Angeles, CA.

Thesis (Ph. D.).

This dissertation deals with the effect of a gradient in the nonlinear and linear susceptibilities on basic nonlinear optical phenomena. We have applied our results to study a linear density variation along the direction of beam propagation in an idealized nonlinear plasma whose nonlinearity arises from the relativistic mass of electrons in strong fields and the V vector x B vector term in the Lorentz force. Such effects are significant for 10 μm wavelength radiation for incident intensities on the order of 10^{16} W/cm^2, and thus are relevant to high power laser-target experiments and pulsar radiation.

FUSION POWER PLANT TECHNOLOGY

51609 (ANL/FPP—77-7) Fusion Power Program. Quarterly progress report, October—December 1977. Baker, C.C.; Darby, J.B. Jr.; Harkness, S.D. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 72p. Dep. NTIS, PC A04/MF A01.

Separate abstracts were prepared for each of the 5 included sections. (MOW)

51610 (PPPL—1444) Natural uranium fueled light water moderated breeding hybrid power reactors: a feasibility study. Greenspan, E.; Schneider, A.; Misolovin, A.; Gilai, D.; Levin, P. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Jun 1978. Contract EY-76-C-02-3073. 223p. Dep. NTIS, PC A10/MF A01.

The first part of the study consists of a thorough investigation of the properties of subcritical thermal lattices for hybrid reactor applications. Light water is found to be the best moderator for (fuel-self-sufficient) FSS hybrid reactors for power generation. Several lattice geometries and compositions of particular promise for LWHRs are identified. Using one of these lattices, fueled with natural uranium, the performance of several concepts of LWHR blankets is investigated, and optimal blanket designs are identified. The effect of blanket coverage efficiency and the feasibility of separating the functions of tritium breeding and of power generation to different blankets are investigated. Optimal iron-water shields for LWHRs are also determined. The performance of generic types of LWHRs is evaluated. The evolution of the blanket properties with burnup is evaluated and fuel management schemes are briefly examined. The feasibility of using the lithium system of the blanket to control the blanket power amplitude and shape is also investigated. A parametric study of the energy balance of LWHR power plants is carried out, and performance parameters expected from LWHRs are estimated. Discussions are given of special features of LWHRs and their fuel cycle.

51611 (UCRL—81149) Mirror fusion reactors. Carlson, G.A.; Moir, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 May 1978. Contract W-7405-ENG-48. 10p. (CONF-780801—1). Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

We have carried out conceptual design studies of fusion reactors based on the three current mirror confinement concepts: the standard mirror, the tandem mirror, and the field-reversed mirror. Recent studies of the standard mirror have emphasized its potential as a fusion-fission hybrid reactor, designed to produce fission fuel for fission reactors. We have designed a large commercial hybrid based on standard mirror confinement, and also a small pilot plant hybrid. Tandem mirror designs include a commercial 1000 MWe fusion power plant and a nearer term tandem mirror hybrid. Field-reversed mirror designs include a multicell commercial reactor producing 75 MWe and a single cell pilot plant.

51612 (UCRL—81154) Mirror Fusion Test Facility (MFTF). Thomassen, K.I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 May 1978. Contract W-7405-ENG-48. 7p. (CONF-780801—2). Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A large, new Mirror Fusion Test Facility is under construction at LLL. Begun in FY78 it will be completed at the end of FY78 at a cost of $94.2M. This facility gives the mirror program the flexibility to explore mirror confinement principles at a signficant scale and advances the technology of large reactor-like devices. The role of MFTF in the LLL program is described here.

51613 Fusion hybrid. Bethe, H.A. *Nucl. News;* **21**: No. 7, 41-44(May 1978).

A brief review is given of the operational principles of a fusion hybrid reactor using thorium in the fuel cycle. The economics and performance of this type of reactor are discussed. (MOW)

51614 Thermonuclear synthesis and nuclear power engineering. Velikhov, E.P.; Kadomtsev, B.B.; Orlov, V.V. (Inst of At Energy im. I.V. Kurchatov, USSR). *Teploenergetika (Moscow);* No. 11, 59-66(Nov 1977). (In Russian).

A state-of-the-art report is presented on the problem of development of nuclear fusion reactors and power plants, and on the research carried on along these lines in the West and in the USSR. It is concluded that the break-even experiment may be realized at the beginning of the eighties and that the first thermonuclear power reactors should appear towards the end of the present century. It is likely that, as the first stage, hybrid reactors will be used, in which the thermonuclear reactor would be a source of neutrons for the production of plutonium from uranium-238 or of uranium-233 from thorium. The advantages of hybrid reactors are pointed out. A balanced plutonium-based nuclear power industry is envisaged, developing at the rate of 10% p.a. Its structure may be as follows: 50-30% fast breeders; 40-55% thermal reactors, and 10-15% hybrid reactors.

51615 Introduction to controlled thermonuclear fusion. Hagler, M.O.; Kristiansen, M. Lexington, MA; D. C. Heath and Co. (1977). 200p. $17.00.

The following topics are covered in this book: (1) background theory, (2) relation of magnetic field curvature and magnetic field

gradients, (3) controlled fusion reactors, (4) breakeven and ignition in fusion reactors, (5) size considerations for fusion reactors, (6) breakeven for laser fusion, (7) tokamaks, (8) random walk, (9) mirror machines, (10) linear and toroidal theta pinches, (11) laser pellet fusion, (12) relation of f/sub B/ to n tau and rho R, (13) plasma frequency and the brand X laser, and (14) sundry approaches to fusion. (MOW)

BLANKET ENGINEERING

51616 (ANL/FPP—77-7, pp 34-36) **Experimental power reactor.** 1977.

In Fusion Power Program. Quarterly progress report, October—December 1977.

This section gives a summary of work during this period on the first wall/limiter design, impurity control, and refueling by pellet injection. (MOW)

51617 (JAERI-M—7111) **Study on impurities and scrape-off layer plasma in a large tokamak.** Shimomura, Y. (Japan Atomic Energy Research Inst., Tokyo). Jun 1977. 18p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The scrape-off layer is studied by using a simple model which gives a low temperature at the edge of a plasma column in the present tokamaks. In a future large tokamak, the scrape-off layer has to be controlled to eliminate the serious impurity contamination from a neutralizer plate (or a limiter) and vacuum walls. One of the suitable scrape-off layers is shown to be cold and thick. Possible methods to obtain this scrape-off layer are also discussed.

51618 **Neutron spectra and tritium production measurements in a lithium sphere to check fusion reaction blanket calculations.** Bachmann, H.; Fritscher, U.; Kappler, F.W.; Rusch, D.; Werle, H.; Wiese, H.W. (Kernforschungszentrum Karlsruhe, Ger.). *Nucl. Sci. Eng.;* **67**: No. 1, 74-84(Jul 1978).

Measured and calculated neutron spectra from a sphere of lithium metal with natural isotopic composition are compared. In the calculations, the investigation is concentrated on the S/sub N/ method with nuclear data from ENDF/B-III for lithium and from KEDAK 3 for iron. A special partition of the angular coordinate, S_{19}, was introduced to allow for the strong anisotropy of the neutron flux in the radial direction. For the proper treatment of the anisotropic elastic scattering, a new technique for improved, extended, and consistent transport approximation up to T_5 is used. These ameliorations being introduced, it is shown that the nonelastic scattering is treated inadequately with respect to the angular and energetic distribution of the outcoming neutrons. The investigation is completed by a comparison of the measured and calculated space-dependent tritium production rate, in which the discrepancy is found consistent with the discrepancy in the neutron spectra. Furthermore, we propose that the $^7Li(n,n'\alpha)$ cross section should be reduced by 15 to 20% with respect to the ENDF/B-III value.

51619 **Medium-energy nucleon-meson transport calculations and electronuclear fuel production.** Alsmiller, R.G. Jr.; Barish, J.; Bartine, D.E.; Burns, T.HJ.; Gabriel, T.A. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **28**: 756-757(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51620 **Shield design for the Joint European Torus.** Avery, A.F.; Chestnutt, M.M. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 64-74 of Reactor shielding. Roussin, R.W.; Abbott, L.S.; Bartine, D.E. (eds.). Princeton, NJ; Science Press (1977).

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

See CONF-770401—.

The shield design for the blockhouse of the Joint European Torus is described. The material chosen was light concrete and the problems examined were direct penetration of the shield walls and skyshine after escape through the blockhouse roof. The Monte Carlo methods developed originally for fission reactor design were applied to this situation, and the ANISN-SWANLAKE codes were used in the estimation of the uncertainties. A wall of thickness 250 cm and a roof of 210 cm were found to meet the shielding requirements.

MAGNET COILS AND FIELDS

51621 (ORNL/TM—6403) **Poloidal magnetic field fluctuations in tokamaks.** Carreras, B.; Waddell, B.V.; Hicks, H.R. (Oak Ridge National Lab., Tenn. (USA)). Jul 1978. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

Elementary nonlinear tearing mode theory in a two-dimensional cylindrical geometry is used to predict accurately the amplitude of the m = 2 poloidal magnetic field fluctuations (Mirnov oscillations) at the limiter of a tokamak. The input required is the electron temperature radial profile from which the safety factor profile can be inferred. The saturation amplitude of the m = 2 tearing mode is calculated from the safety factor profile using a nonlinear Δ' analysis. This gives an absolute result (no arbitrary factors) for the amplitude of the perturbation in the poloidal magnetic field everywhere, in particular, at the limiter. An analysis of ORMAK and T-4 safety factor profiles (inferred from electron temperature profiles) gives results that are in agreement with the experimental data. A study of a general profile shows that as a function of the safety factor at the limiter, a maximum occurs in the amplitude of the Mirnov oscillation. The magnitude of the maximum increases with a decrease in temperature near the limiter.

POWER SUPPLIES, ENERGY STORAGE

51622 (ANL/FPP—77-7, pp 47-48) **Magnetic systems.** 1977.

In Fusion Power Program. Quarterly progress report, October—December 1977.

This section gives brief discussions on the energy storage and transfer program and on the development of a negative ion source. (MOW)

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 51626

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 51616

51623 (BNL—50727, pp 136-139) **Multidipole negative ion source.** Leung, K.N. (James Madison Univ., Harrisonburg, VA). 1977.

From Symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (26 Sep 1977).

In Proceedings of the symposium on the production and neutralization of negative hydrogen ions and beams.

51624 (GA-A—14940) **Preliminary evaluation of the ^{233}U refresh cycle hybrid power system concept.** Schultz, K.R.; Brogli, R.H.; Hopkins, G.R.; Bullock, R.; Lund, K.O.; Wong, C.; Bender, D.J.; Lee, J.D. (General Atomic Co., San Diego, Calif. (USA)). Apr 1978. Contract EY-76-C-03-0167-038. 12p. (CONF-780508—15). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

A preliminary evaluation was made of the technical feasibility of using a fusion reactor to breed ^{233}U from thorium in high temperature gas cooled fission reactor fuel and then using this fuel in a fission reactor without reprocessing. Estimates of the neutronic performance of thorium fusion reactor blankets indicate that adequate concentration of ^{233}U in thorium can be attained to allow operation of a high temperature gas cooled reactor using nonreprocessed fusion-bred ^{233}U fuel. Estimates of the fuel materials damage indicate that the breeding and subsequent burning of ^{233}U can be accomplished within the currently predicted materials limitations of high temperature gas-cooled reactor fuel. The system performance of this symbiotic fusion-fission power system, called the U-233 Refresh Cycle Hybrid Power System, was estimated. A refresh cycle fusion breeder reactor could support from two to three high temperature gas cooled fission burner reactors of equal thermal power without reprocessing. Greatly improved performance is possible if reprocessing is allowed. Thus preliminary evaluation shows that the concept is technically feasible and warrants more detailed study.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

51625 (ANL/FPP—77-7, pp 37-46) **Fusion systems engineering.** 1977.

In Fusion Power Program. Quarterly progress report, October—December 1977.

Summaries of research are included for each of the following topics: (1) fusion reactor systems studies, (2) development of blanket processing technology for fusion reactors, (3) safety studies of fusion concepts, (4) the MACK/MACKLIB system for nuclear response functions, and (5) energy storage and power supply systems for fusion reactors. (MOW)

51626 (CONF-780508—12) **Tritium permeation through Incoloy 800 oxidized in situ by water vapor.** Bell, J.T.; Redman, J.D.; Bittner, H.F.; Christie, W.H. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

The in situ formation of oxide layers on the surfaces of heat exchangers in the steam system of a fusion power plant may be the

most feasible way to control tritium release into the steam. Tritium permeabilities of Incoloy 800 have been determined while the downstream surface was oxidized by water vapor at 525, 660 and 720°C. The in situ formation of oxide coatings on the Incoloy 800 surface has been observed to reduce tritium permeabilities by factors of 30 to 700 depending on conditions. The effects of the in situ formed oxide coatings to impede tritium permeation are dependent on the chemical and physical compositions of the oxides, and the compositions of the oxides have been observed to depend on the history of the material.

51627 (LA-UR—78-1274) **Tritium Systems Test Assembly at the Los Alamos Scientific Laboratory.** Anderson, J.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 7p. Dep. NTIS, MF A01.

From 3. American Nuclear Society topical meeting on the technology of controlled nuclear fusion, Santa Fe, NM, USA, 9 May 1978. Portions of document are illegible.

The Tritium Systems Test Assembly (TSTA) is dedicated to the development, demonstration, and interfacing of technologies related to the deuterium-tritium fuel cycle for fusion reactor systems. The principal objectives for TSTA are: (a) demonstrate the fuel cycle for fusion reactor systems; (b) develop test and qualify equipment for tritium service in the fusion program; (c) develop and test environmental and personnel protective systems; (d) evaluate long-term reliability of components; (e) demonstrate long-term safe handling of tritium with no major releases or incidents; and (f) investigate and evaluate the response of the fuel cycle and environmental packages to normal, off-normal, and emergency situations.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 50829, 50834, 51569, 51615

51628 (COO—2765-8) **[Study of the acceleration, focusing, and bunching ions by electronic space charge for pellet fusion]. Progress report, November 1, 1977—January 31, 1978.** (Illinois Univ., Urbana (USA). Gaseous Electronics Lab.). 1978. Contract EY-76-S-02-2765. 10p. Dep. NTIS, PC A02/MF A01.

Copies of slides presented at the Inertial Confinement Fusion meeting in San Diego, California are given. The diagrams show experimental data on plasma ion sources, beam transport, and target compressions. (MOW)

51629 (JEN—395) **Self-similar motion of laser half-space plasmas. 1. Deflagration regime.** Sanmartin, J.R.; Barrero, A. (Junta de Energia Nuclear, Madrid (Spain)). 1977. 41p. (In English). Dep. NTIS (US Sales Only), PC A03/MF A01.

The one-dimensional self-similar motion of an initially cold, half-space plasma of electron density n_0, produced by the (anamalous) absorption of a laser pulse of irradiation phi=phi$_0$t/tau ($0<t<=tau$) at the critical density nsub(c)(nsub(c)/n_0=epsilon<<1), is considered; the analysis allows for electron heat conduction and ion-electron energy exchange (viscosities and ion conduction are found negligible) and retains three dimensionless numbers: epsilon, Zsub(i) (ion charge number), and a parameter αsup(infinity)(n_0^2tau/phi$_0$)sup(2/3). For $\alpha>>$epsilonsup(-4/3), a deflagration wave (where energy absorption occurs) develops, separating an isentropic compression with a shock bounding the undisturbed plasma, and an isentropic expansion flow to the vacuum. The structures of these three regions are completely determined; in particular, the Chapman-Jouguet condition is proved and the density behind the deflagration is found. The deflagration-compression thickness ratio is large (small) for $\alpha<<$epsilonsup(-5/3) ($\alpha>>$epsilonsup(-5/3)). There is a thin transition layer ahead of the deflagration, where density has a maximum and temperature a minimum.

51630 (LA—7218-MS) **Simple model for exploding pusher targets.** Giovanielli, D.V.; Cranfill, C.W. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

A simple analytic model for the behavior of thin-walled, DT-filled spherical shells irradiated with high-intensity laser light has been developed. We show that experimental results obtained with these targets can be explained well with the model over the range of laser intensities that have been used.

51631 (UCRL—52349) **Civilian applications of laser fusion.** Maniscalco, J.; Blink, J.; Buntzen, R.; Hovingh, J.; Meier, W.; Monsler, M.; Walker, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Nov 1977. Contract W-7405-ENG-48. 104p. Dep. NTIS, PC A06/MF A01.

The commercial aspects of laser fusion were evaluated in an attempt to relate the end products (neutrons and energy) to significant commercial applications. It was found that by far the largest markets and highest payoffs for laser fusion are associated with electric power production. Hence, much of this report evaluates the prospects of producing commercial electricity with laser fusion. To this end, we have described in detail a new and promising laser fusion concept—the liquid lithium waterfall reactor. In addition, we have taken the most attractive features from our laser studies and used them to compare laser fusion to other long-range sources of energy (breeder reactors and solar energy). It is our contention that all three sources of electrical energy should be developed to the point where the final selections are primarily based on economic competitiveness. The other potential applications of laser fusion (fissile fuel production, synthetic fuel production, actinide burning, and propulsion) are also discussed, and our preliminary plan for the engineering development of laser fusion is presented.

51632 (UCRL—79444) **Optical components for the SHIVA laser.** Wallerstein, E.P.; Marchi, F.T.; Whistler, W.T.; Bissinger, H.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Dec 1977. Contract W-7405-ENG-48. 16p. (CONF-780140—1). Dep. NTIS, PC A02/MF A01.

From SPIE conference; Los Angeles, CA, USA (16 Jan 1978).

SHIVA, the 10-kilojule Neodymium-glass laser for the High Energy Laser Facility at Lawrence Livermore Laboratory has been built, exceeded minimum energy predictions, and is currently being applied to laser fusion experiments. The twenty, 20-cm aperture arms contain a total of about 1500 optical components for beam propagation, and another 1000 elements are used for control systems and diagnostics. In order to focus the energy on targets smaller than 1 mm in diameter, it has been necessary to maintain very high optical quality throughout the system. The manufacturing and testing technologies involved in meeting this challenge have been noteworthy and have encompassed glass manufacturing, optical finishing, and coating, for elements as diverse as Faraday rotators, laser rods and disks and aspheric lenses.

51633 (UCRL—80538) **Jet stability in the lithium fall reactor.** Kang, S.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 May 1978. Contract W-7405-ENG-48. 7p. (CONF-780508—14). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

A preliminary analysis has been made of the various hydrodynamic aspects involved in the stability of a liquid-lithium jet in a laser-fusion reactor, which comprises a part of LLL's laser fusion power-generation concept. Various physical factors that may affect the jet breakup are delineated, and some approximate calculations are performed to determine their relative influences. Areas of uncertainty are pointed out, along with plans for experimental verification or further theoretical analysis.

51634 **Laser fusion experiments at 4 TW.** Storm, E.K.; Ahlstrom, H.G.; Boyle, M.J.; Campbell, D.E.; Coleman, L.W.; Glaros, S.S.; Kornblum, H.N.; Lerche, R.A.; MacQuigg, D.R.; Phillion, D.W.; Rainer, F.; Rienecker, R.; Rupert, V.C.; Slivinsky, V.W.; Speck, D.R.; Swift, C.D.; Tirsell, K.G. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev. Lett.;* **40**: No. 24, 1570-1573(12 Jun 1978).

DT-filled glass microspheres have been imploded at power levels exceeding 4 TW using the Lawrence Livermore Laboratory 1.06-μm Argus laser. Thermonuclear neutron yields in excess of 1.5 x 10^9 have been observed implying a DT burn efficiency of 1.6 x 10^{-5}. Neutron and α time-of-flight measurements indicate DT burn temperatures of 4—8 keV, implying that a DT gain of approximately 10^{-2} and a ntau of 10^{12} were obtained.

51635 **Pulse-power particle beam sources as fusion drivers.** Kuswa, G.W. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **28**: 31-32(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

51636 **Inertial confinement fusion by high-energy heavy ions.** Martin, R.L. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **28**: 32(Jun 1978).

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

See CONF-780622—.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 50704, 51620

51637 (ANL/FPP—77-7, pp 1-33) **Fusion reactor materials.** 1977.

In Fusion Power Program. Quarterly progress report, October—December 1977.

Data are given for each of the following areas: (1) depth distribution of bubbles in 20-keV $^4He^+$ irradiated nickel, (2) surface damage of Al irradiated with $^4He^+$ to high doses, (3) secondary photon emission from ion bombarded surfaces, (4) dosimetry and damage analysis work in support of the MFE materials program, (5) hydrogen permeation and materials behavior in alloys, (6) radiation damage of diagnostic windows in TFTR, and (7) fast neutron irradiations of superconducting Nb_3Sn. (MOW)

51638 (UCID—17816) **DT fusion neutron irradiation of LLL NbTi superconductor wires at 4.2°K and University of Oxford Cu_3Au TEM specimens at room temperature, April 7, 1978.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 May 1978. Contract W-7405-ENG-48. 8p. Dep. NTIS, PC A02/MF A01.

The DT fusion neutron irradiation of two LLL NbTi superconductor wires at 4.2°K and 14 University of Oxford Cu_3Au TEM specimens at room temperature is described. The sample position, beam-on time, and neutron dose record are given. The results from four profile dosimetry foils measuring the lateral variation in neutron flux are given.

51639 (UCID—17817) **DT fusion neutron irradiation of LLL stainless steel tensile specimens, February 23, 1978.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 May 1978. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

The DT fusion neutron irradiation of nine LLL stainless steel tensile specimens is described. The sample position, beam-on time and dose record are given. The maximum neutron fluence on any sample was 2.20×10^{17} neutrons/cm^2.

51640 (UCID—17818) **DT fusion neutron irradiation of LLL niobium, March 29, 1978.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 May 1978. Contract W-7405-ENG-48. 5p. Dep. NTIS, PC A02/MF A01.

The DT fusion neutron irradiation of February 13 to 17, 1978 is briefly outlined by the neutron dose record and the neutron fluences on 19 dosimetry foils.

51641 Solution of the vacuum problem for thermonuclear systems. Drui, O.S.; Lesnyakov, G.G.; Skibenko, E.I.; Sorokovoi, L.G.; Kholod, Yu.V.; Yuferov, V.B. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). pp 2691-2694 of Proceedings of the seventh international vacuum congress and the third international conference on solid surfaces. Vol. 3. Dobrozemsky, R.; Ruedenauer, F.; Viehboeck, F.P.; Breth, A. (eds.). Vienna; Oesterr. Studiengesellschaft fuer Atomenergie G.m.b.H. (Sep 1977).

From 7. international Vac. congress and 3. international conference on solid surfaces; Vienna, Austria (12 Sep 1977).

The physical factors determining vacuum conditions in thermonuclear systems are discused. The dependence of the divertor gas efficiency on the geometry is studied. On the basis of the calculations the structure of plasma absorption chambers in the divertor system is chosen. The requirements to the divertor vacuum system and the pumping system are formulated. The choice of cryopumps is illustrated by some parameters. The parameters of the coolant-providing system are determined.

51642 New types of volume gettering panels for vacuum problems in plasma machines. Ferrario, B.; Rosai, L. (S.A.E.S. Getters s.p.A., Milan, Italy). pp 359-362 of Proceedings of the seventh international vacuum congress and the third international conference on solid surfaces. Vol. 1. Dobrozemsky, R.; Ruedenauer, F.; Viehboeck, F.P.; Breth, A. (eds.). Vienna; Oesterr. Studiengesellschaft fuer Atomenergie G.m.b.H. (Sep 1977).

From 7. international Vac. congress and 3. international conference on solid surfaces; Vienna, Austria (12 Sep 1977).

A new type of volume getter pump is presented. They have a maximized specific pumping speed for $H_2$and its isotopes and allow an easy modular construction of complete pumping systems. These can be arranged in flat panels, suitable as an alternative to titanium sublimitation pumps and cryopanels in the fusion field. The application of these 'Wafer' like pumps to the various parts of JET has been proposed in a feasibility study contract between the European Atomic Energy Community and S.A.E.S. Getters S.p.A. Pumping speed and capacity figures are given and discussed. Operating conditions for cyclic storing and releasing of H_2 and its isotopes are indicated. Conditions are also discussed for application in neutral beam injectors allowing for the expected thermal loads involved.

51643 Design of large vacuum seals for nuclear fusion machines. Wheeler, W.R. (Tencor Instruments, Mountain View, California, USA). pp 251-254 of Proceedings of the seventh international vacuum congress and the third international conference on solid surfaces. Vol. 1. Dobrozemsky, R.; Ruedenauer, F.; Viehboeck, F.P.; Breth, A. (eds.). Vienna; Oesterr. Studiengesellschaft fuer Atomenergie G.m.b.H. (Sep 1977).

From 7. international Vac. congress and 3. international conference on solid surfaces; Vienna, Austria (12 Sep 1977).

Ordinary sizes of vacuum seals have become commonplace in modern equipment. Metal valve main seals larger than 65 mm diameter and flange seals larger than 400 mm diameter are not in this class and their reliability continues to be a matter of concern. Large size nuclear fusion machines of the Tokamak family now in advanced planning stages pose requirements for very large flange and valve seals of all-metal construction which must be remotely operated. The mechanical properties of gaskets, flanges and seal force mechanisms of successful designs are examined for their applicability. The all-important effects of non-uniform heating are also considered. New designs are described.

51644 Outgassing rates before, during and after bake-out for various vacuum and first wall candidate materials of a large tokamak device. Yoshikawa, H.; Gomay, J.; Sugiyama, Y.; Mizuno, M.; Komiya, S.; Tazima, T. (Ulvac Corp., Chigasaki, Kanagawa (Japan)). pp 367-370 of Proceedings of the seventh international vacuum congress and the third international conference on solid surfaces. Vol. 1. Dobrozemsky, R.; Ruedenauer, F.; Viehboeck, F.P.; Breth, A. (eds.). Vienna; Oesterr. Studiengesellschaft fuer Atomenergie G.m.b.H. (Sep 1977).

From 7. international Vac. congress and 3. international conference on solid surfaces; Vienna, Austria (12 Sep 1977).

Outgassing rates of vacuum wall candidate materials; stainless steel SS-304L and YUS-170, Inconel-625 and Hastelloy-X, and first wall materials; molybdenum, pyrolytic graphite and silicon carbide are measured before, during and after a bake-out at 500°C. The outgassing rate from the inside wall of the cylinder made of each material is estimated from the pressure difference between before and after a calibrated orifice. The ultimate outgassing rates of SS-304L and pyrolytic graphite, and YUS-170 Inconel-625, Hastelloy-X and molybdenum are the orders of 10^{-10} and 10^{-11} Pa.l.s^{-1} cm^{-2}, respectively.

GENERAL AND MISCELLANEOUS

51645 (JPRS—71173) **Translations on Eastern Europe. Scientific Affairs No. 584.** 24 May 1978. Translation of various papers. 30p. NTIS.

The serial report contains articles concerning the development of and progress in the various theoretical and applied scientific disciplines and technical fields; and the administration, structure, personnel, and research plans of leading East European scientific organizations and institutions, particularly the academies of sciences.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 51659

51646 (BNL—24496) **Constructive polynomial approximation in Sobolev spaces.** Dupont, T.; Scott, R. (Chicago Univ., Ill. (USA). Dept. of Mathematics; Brookhaven National Lab., Upton, N.Y. (USA)). Jun 1978. Contract EY-76-C-02-0016. 16p. (CONF-780586—1). Dep. NTIS, PC A02/MF A01.

From Symposium on recent advances in numerical analysis; Madison, WI, USA (22 May 1978).

A simple, constructive proof of the so-called Bramble—Hilbert Lemma is presented. This result is frequently used in establishing the approximation properties of finite-element function spaces, and several of the extensions studied here are directed to this type of application. Some examples of the uses of these results are presented.

51647 (EPRI-NP—767) **GO methodology—fault sequence identification and computer code manual. Final report.** Chu, B.B. (Kaman Sciences Corp., Colorado Springs, Colo. (USA)). May 1978. 317p. Dep. NTIS, PC A14/MF A01.

GO methodology is a computerized system reliability analysis technique. The methodology consists of two parts, system reliability evaluation and system fault sequence identification. The method employs a straightforward inductive logic for constructing system models; all possible system response modes, both successes and failures, are then determined. This is the second of two companion reports to EPRI NP-765, GO Methodology, An Overview. This annual provides documentation of the Fault Finder programs SYSFILE, FF1, and FF2. 68 figures, 69 tables.

51648 (LA—7258-MS) **Large-scale scientific computation at the Los Alamos Scientific Laboratory.** Buzbee, B.L. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1978. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

This report was developed from the text of a talk given at the 1977 fall meeting of the Society for Industrial and Applied Mathematics. Performance and architectural trends in supercomputers are surveyed, and it is shown how various aspects of the large-scale numerical simulation process affect computational facilities. Plans for utilizing the CRAY-1 computer, as well as other future supercomputers, are discussed. In conclusion, speculations about how numerical analysis may be affected by current trends in supercomputers are offered. 9 figures.

51649 (LA—7287-MS) **Number of solutions of a linear inequality (a knapsack problem).** Everett, C.J.; Stein, P.R. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1978. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

Let N(M) denote the number of integral solutions (n_1, ..., n/sub K/), n/sub k/ greater than or equal to 0, of the inequality Σ_1/sup K/ w/sub k/ n/sub k/ less than or equal to M, where M and w_1, ..., w/sub K/ are given positive real numbers, and s = Σ_1/sup K/ w/sub k/, p = PI_1/sup K/ w/sub k/. It is easy to obtain the bounds M/sup K//(K-factorial) p less than or equal to N (M) less than or equal to (M + s)/sup K//(K-factorial) p, and hence the asymptotic form N(M) asymptotically equals M/sup K//K-factorial p. The question is raised whether the stricter upper bound B(M) = PI_1/sup K/ (M + s(k/K))/(K-factorial) p may obtain. This is indeed true in the case of equal w/sub k/, and in the general cases K = 1, 2, 3, 4. Some interesting conjectures on inequalities arise in the course of the work, which is in the nature of a progress report on the present state of the problem.

51650 (LBL—7250) **How to improve your performance through obfuscatory measurement.** Stevens, D.F. (Los Alamos Scientific Lab., N.Mex. (USA)). Jan 1978. Contract W-7405-ENG-48. 20p. (CONF-780615—1). Dep. NTIS, PC A02/MF A01.

From National computing conference; Anaheim, CA, USA (5 Jun 1978).

A summary of the techniques of obfuscatory measurement in common use today is given, with examples showing their use in the creative measurement of computer performance.

51651 (TID—28464) **Characterization of group-divisible designs and some related results.** Cheng, C.S.; Gray, L.J. (California Univ., Berkeley (USA); Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.). [nd]. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

A regular graph is a graph with no multiple edges and loops such that each of its vertices is adjacent (or connected) to the same number of other vertices. The optimality of some special types of regular graph designs for the elimination of one-way heterogeneity has already been proven. The main purpose of this work is to show that these designs are group-divisible. The problem is formulated and solved in the context of graph theory. (RWR)

51652 (UCID—17841) **File management system.** Loomis, H.H. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jun 1978. Contract W-7405-ENG-48. 46p. Dep. NTIS, PC A03/MF A01.

A file management system is proposed which will operate within the existing LLL Octopus system, and yet give many desired file handling characteristics. The basic philosophy of the system is to use storage of multiple copies of a given file as the means for increasing the likelihood of successful recovery of a given file. Furthermore, the use of different type file storage devices to store the copies will improve accessibility by permitting access to at least one copy of the file even in the event of failure of any single type of storage device. The body of the paper presents a discussion of current and planned Octopus storage characteristics, the definition of the details of the proposed file management system, a discussion of the system from the user's point of view, and implementation costs and some implementation alternatives. 3 figures, 8 tables. (RWR)

51653 (UCRL—52417) **Portable LISP interpreter.** Cox, L.A. Jr.; Taylor, W.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 May 1978. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

A portable LISP interpreter that includes all the major list-processing functions is described. A complete, annotated listing of the program's code, written in PASCAL, is included.

51654 **New algorithm for adaptive multidimensional integration.** Lepage, G.P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *J. Comput. Phys.;* **27**: No. 1, 192-203(May 1978).

A new general purpose algorithm for multidimensional integration is described. It is an iterative and adaptive Monte Carlo scheme. The new algorithm is compared with several others currently in use, and shown to be considerably more efficient than all of these for a number of sample integrals of high dimension (n> or ≈4).

51655 **Method for parameter sensitivity analysis in differential equation models.** Kohberger, R.C. (Albany Medical Coll.); Scavia, D.; Wilkinson, J.W. *Water Resour. Res.;* **14**: No. 1, 25-29(Feb 1978).

A numeric method for analyzing global parameter sensitivity about a fixed point in parameter space for differential equation models is presented. The method is suitable for large-scale, multiresponse systems which may not be in steady state. By using a quadratic model, the relationship between several global response characteristics and parameter perturbations is examined. Sensitivity relationships are defined with both backward elimination regression model selection procedures and eigenvalue-eigenvector analyses. An example of the method is given using an ecosystem model consisting of 14 coupled differential equations.

51656 **UKSC 78. Proceedings of the 1978 UKSC conference on computer simulation.** Surrey, England; IPC House (1978). 566p. (CONF-780439—).

From UKSC conference on computer simulation; Chester, UK (Apr 1978).

This volume contains papers presented at the 1978 Conference on Computer Simulation held in Chester on April 4-6, 1978. The papers fall mainly in the sphere of continuous simulation, but there are also some on discrete aspects. Topics covered include the following: continuous simulation languages; aerospace applications; physiology and medicine; mechanical, chemical, and industrial processes; corporate and economic modeling; numerical techniques; and hardware aspects. Two papers are abstracted individually for Energy Research Abstracts (ERA), one of them also selected for Energy Abstracts for Policy Analysis (EAPA). (RWR)

51657 **Secant method for multiple roots.** King, R.F. *Bit;* **17**: No. 3, 321-328(1977).

A superlinear procedure for finding a multiple root is presented. In it the secant method is applied to the given function divided by a divided difference whose increment shrinks toward zero as the root is approached. Two function evaluations per step are required, but no derivatives need be calculated. 3 tables.

51658 **Behavior of the Pade table for the exponential.** Saff, E.B. (Univ. of Florida, Tampa); Varga, R.S. pp 519-531 of Approxmation theory. II. New York; Academic Press, Inc. (1976).

Recent results are surveyed and some new theorems on the behavior of Pade approximants for e/sup -z/ are presented. The new results include necessary and sufficient conditions for (1) a sequence of approximants to be pole-free in an infinite sector, and (2) a sequence of approximants to converge geometrically in the uniform norm over an infinite sector.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 50405, 50406, 50442

51659 (LA-UR—78-721) **Chernoff faces.** Bruckner, L.A. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 30p. (CONF-780245—1). Dep. NTIS, PC A03/MF A01.

From Symposium on graphical representation of multivariate data; Monterey, CA, USA (24 Feb 1978).

Chernoff introduced the idea of using faces to represent multidimensional data in 1971. Since then, this technique has been used in a wide variety of applications. The first part of this paper discusses how to use the technique. Then Andrews' sine curves and Anderson's metroglyphys are introduced and compared to the facial representations. Dependencies among the facial features are considered next, and a way to eliminate dependencies is presented. Finally, some uses of Chernoff faces at the Los Alamos Scientific Laboratory are mentioned. 8 figures, 5 tables.

51660 (SAND—78-1055C) **Material lists (ML's): an interagency file system.** DeVore, R.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 15 May 1978. Contract EY-76-C-04-0789. 23p. (CONF-780547—1). Dep. NTIS, PC A02/MF A01.

From IMOG/NSG meeting; Amarillo, TX, USA (16 May 1978).

The topic of the report is the material list (ML) and its interagency file system. The ML system is a subsystem of the automated design definition system (ADDS). The author explains the interagency machine operations group (IMOG) and the subgroup on product definition systems, explains briefly what ADDS is, points out the need for moving alpha-numeric design definition data between design and production agencies, shows the main features of the system developed to move and control data between agencies, and compares the needs of handling alpha-numeric data to the needs

of computer-aided design data when considering use at multiple agencies. 22 figures. (RWR)

51661 (TID—4584-R3) **Energy information data base: Subject categories.** (Department of Energy, Oak Ridge, Tenn. (USA). Technical Information Center). May 1978. 82p. Dep. NTIS, PC A05/MF A01.

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. These numbers are used in the preparation of printed documents, such as bibliographies and abstract journals, and as searching aids in the on-line system, RECON. The meaning attached to each of these numbers is explained in this document. It was prepared for use by those individuals responsible for the assignment of category numbers to documents being entered into the TIC system, those individuals and organizations processing magnetic tape copies of the files, and others who, having no access to RECON, have need for printed copy. (RWR)

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Aerojet Energy Conversion Co., Sacramento, Calif. (USA)
Geothermal absorption refrigeration for food processing industries. Final report, December 13, 1976—November 13, 1977, 3:49865 (SAN—1319-1)

AiResearch Mfg. Co. of Arizona, Phoenix (USA)
Ceramic technology readiness program. Seventh monthly technical progress report, April 3, 1978—April 30, 1978, 3:50706 (FE—2664-7)

Alabama Univ., Huntsville (USA). Center for Environmental and Energy Studies
Proceedings of the national solar energy workshop of the ERDA Division of Solar Energy and the State Energy Offices, held in Huntsville, Alabama, May 19—21, 1976, 3:49771 (TID—28468)

American Association of Petroleum Geologists, Inc., Midland, Tex.
AAPG—SEPM program and abstracts, June 12—16, 1977, 3:49527 (CONF-7706128—(Absts.))

AN SSSR, Moscow. Inst. Prikladnoj Matematiki
Tables of thermodynamic functions of a substance at a high concentration of energy, 3:51543 (UCRL-Trans—11373)

AN SSSR, Moscow. Inst. Vysokikh Temperatur
Investigation of the processes caused by the use of an alkali additive in MHD units operating on natural gas, 3:50539 (ANL-Trans—1122)

AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki
Picosecond time-of-flight spectrometer for the VEPP-2M based on local-discharge spark counter, 3:50949 (SLAC-Trans—184)

Argonne National Lab., Ill. (USA)
Absolute measurements of the ^{233}U (n,f) cross section between 0.13 and 8.0 MeV, 3:51491 (ANL/NDM—36)
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Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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2	3:50798	*See* BDX-613-2018
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12	3:50822	*See* Y/LA-789
13	3:51513	*See* DP-MS-77-83
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12	3:51626	Dep. NTIS, PC A02/MF A01
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CONF-780542-		(American Nuclear Society topical conference final program, Mayaguez, Puerto Rico, 30 Apr-4 May 1978)
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3	3:50829	*See* UCRL-81081
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CONF-780571-		(153. meeting of the Electrochemical Society, Seattle, WA, USA, 21-26 May 1978)
4	3:50670	*See* SAND-78-1091C
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1	3:51646	*See* BNL-24496
CONF-780587-		(6. CODATA conference, Palermo, Italy, 22-25 May 1978)
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3	3:50663	*See* UCRL-80740
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6	3:49722	*See* SAND-78-1242C
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5	3:51251	*See* RFP-2777
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Issue 4

October 1977

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A09	9.00	E09	17.50	T09	500.00
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A13	11.00	E13	28.00	T13	675.00
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